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# Electrical World

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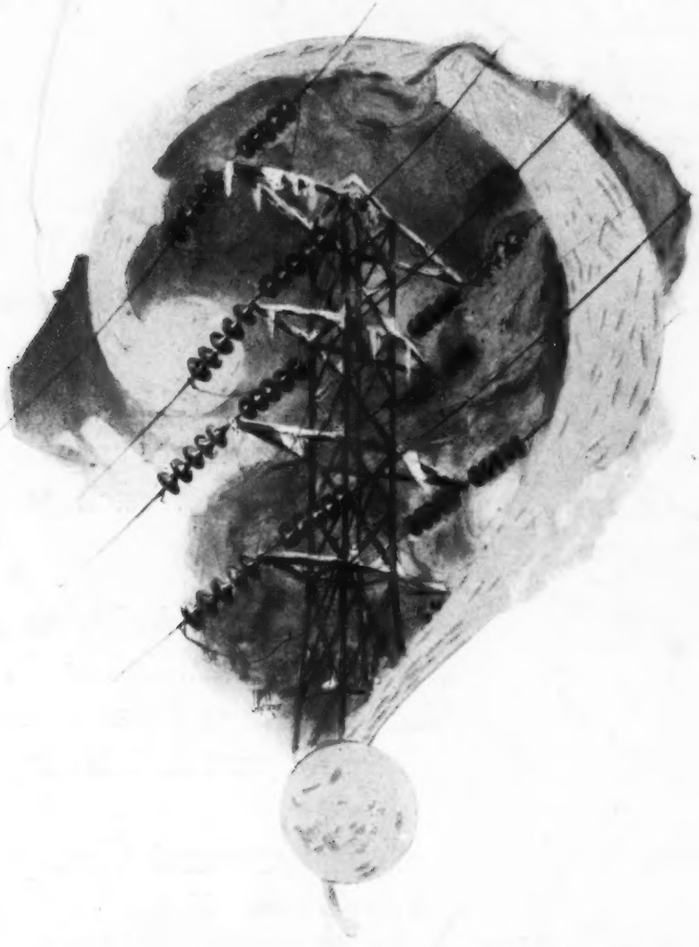

# To *Paint* or To *Galvanize* Steel Structures?

What Field Experience Shows on This Debated Subject
Including Direct Quotations from Twenty-four Operating Companies

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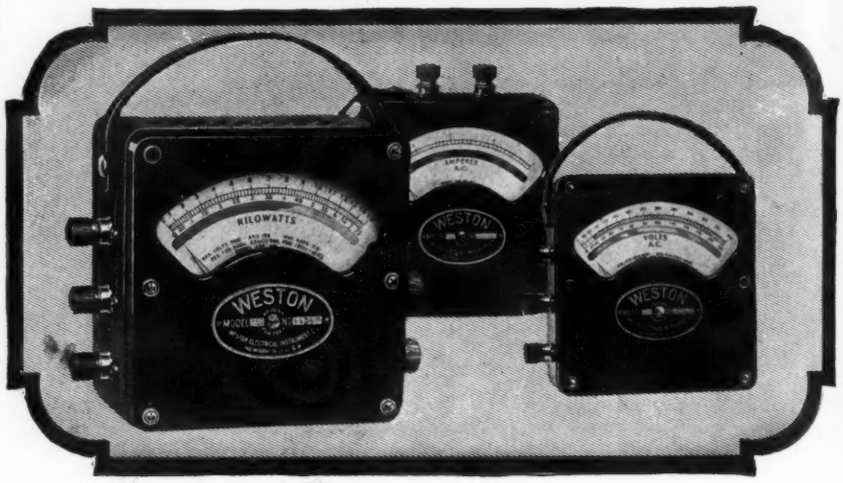
# A Group of SMALL Instruments That Have NO Equal

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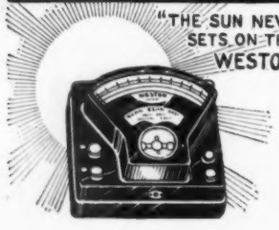


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# Electrical World

*The consolidation of Electrical World, Electrical Engineer and American Electrician*

Published by McGraw-Hill Company, Inc.

W. H. ONKEN, JR. — Editor

HAROLD V. BOZELL — Editor

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## The Essence of Public Relations

HERE is a healthful message for all utility executives. It comes from the heart of an American citizen — a householder, a consumer, a customer, one of those buyers of service and securities who regulate and in the last analysis own all public utilities. It is for this man and others like him that public service corporations are operated. He writes:

What better advertising matter could the Chamber of Commerce of Syracuse have than a reprint of the article in the April 14 issue of the *Electrical World* describing the wonderful service rendered by the Syracuse Lighting Company? If any other large lighting companies in this country are giving service that in any way approaches that of the Syracuse company, please print a few more stories about them. Give them your front-page editorial space. They have earned it. Perhaps if a few of these stories appeared some of the other central stations in the country would wake up enough to be ashamed of their methods and would reform.

I was once with one of the largest managing organizations of this country. I know the problem from the inside. And let me say right here that I do not believe that the problem is one bit harder than the sales problems of large non-public utility organizations. My sympathy has always been for the utility, but I confess that it is waning for one utility whose annual output ranks high in your recent list. Here is the way that utility does it:

On rather short notice I found it necessary to change my apartment. I went to the main office of the lighting company to request the change. Before me was a sign telling all comers that the business of the company is service. I waited twenty-five minutes in front of my sign-greeting. This time was not all wasted because I was entertained by the troubles of others. I could hear only the eight directly in front of me. Three of these eight came about new problems. Five had complaints.

When my turn came I was instructed where to sign and told that accedance to my desire to have the service changed in one week was rather doubtful as the company required a ten-day notice and in addition this was its busy season. I was assured, however, that the matter would have the company's best attention. While I waited the locations were looked up, verified, and, as if to cheer me up, I was told that my move was to a new apartment and that a permit for connection had been issued to cover the entire building. My impatience at waiting had subsided, and I went away feeling that the company had a large problem on its hands and that I really might have service in a week instead of ten days.

Moving day arrived. No electric service. A telephone call gave me the information that no permit had been issued. No arguing on my part about the casual remark made at the main office on this subject when I applied for the change was of avail. What was I to do? Oh, I could call the main office and tell them they were all wrong on the permit stuff, or I could get the owner of the apartment to get after the town wire inspector.

I called the town wire inspector myself, and he told me that he would issue a permit any time the lighting company requested it. He had inspected the building but only issued service connection permits when the lighting company requested them for each apartment.

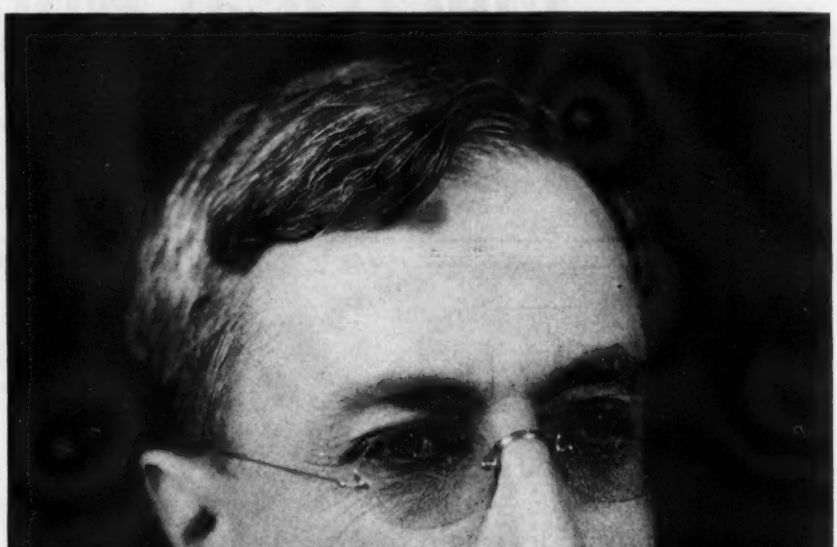
Another call to the lighting company. They agree to connect. When? Tomorrow, perhaps; no connections were made in that town on Tuesdays. Result, I go to the corner store and buy my candles, and forever and a day—try as I will to forget this petty incident—I will just naturally feel that the company cares not for its customers and that I must do my part as a loyal citizen to oppose any rate increases.

Perhaps I had better take an active part in the local movement to require the lighting company to place all of its wires on the main streets underground. No, I am not a grouch by nature, so I am going up to the gas office to smoke a cigar with the manager. He changed my service on the day I wanted it changed and did it all by telephone request. But, then, the gas company only serves a territory of thirty thousand people and the lighting company serves one of over a million. Perhaps that is why the gas company is still a he while the lighting company is they.

PICTURED in this letter we have the very essence of public relations—that thing in which the industry is so absorbed today. It seems a small matter from within — the coming of a stranger to the application window. But these are the contacts of which good will is builded, the elements in service which make the central station and its manager well and favorably known — or not.

# James Berry Foote

*A pioneer in the development of hydro-electric power and transmission and a constructive influence in interurban railway practice.*



THE economical utilization of hydro-electric power has been made possible by high-voltage transmission, and in the development of engineering equipment and methods some remarkable contributions have been made by central-station engineers.

James Berry Foote, pioneer in the development of hydro-electric power and transmission at high voltage in southern Michigan and chief engineer of the Consumers' Power Company, was born at Adrian, Mich., in 1867. His early electrical experiments were made in Adrian, and he started the plant that furnished the first electric light in that community. He went to Jackson in 1886, where in company with his elder brother, W. A. Foote, he initiated the first comprehensive street-lighting system, one which later developed into the present system of the Consumers' Power Company.

It is in the development of high-potential transmission lines and equipment that Mr. Foote's most important engineering work has been carried out. In 1898 he designed and built the transmission line, 25 miles in length and operated at 25,000 volts, from the Trowbridge, Otsego and Plainwell plants on the Kalamazoo River to Kalamazoo. Between 1900 and 1902 he raised the voltage of this line to 40,000 and extended it to Jackson, a total distance of 93 miles. In 1905 the transmission line from Rogers Dam, on the Muskegon River, to Grand Rapids, 55 miles long, was built and placed in service at 72,000 volts. So far as is known this was the highest transmission voltage in use in the world at that time.

In 1906 the Croton-Grand Rapids line was built and placed in service and operated at 110,000 volts. This line, 43 miles in length, was one of the earliest to use the steel tower and suspension-type insulator. The 140,000-volt transmission line from the Au Sable River generating plants to Saginaw, Flint and Owosso was designed by Mr. Foote and placed in service without revision in 1911. This line was originally 151 miles long, on steel towers, with suspension insulators, and was the highest-voltage transmission line in the world for several years.

The 140,000-volt line now extends from Mio, on the Au Sable River, to Battle Creek and Jackson, a total distance of 343 miles. With the 175-mile line from the Manistee River to Kalamazoo and Battle Creek, the Consumers' Power Company now has a total of 517 miles of 140,000-volt lines in operation. By Mr. Foote's constructive leadership in transmission-line design the distance of economical transmission of power has been increased to over 300 miles.

# Editorial Comment

Electrical World, April 28, 1923

Volume 81 Number 17

### Relative Effectiveness of Direct and Indirect Illumination

NO SUBJECT connected with illumination has been the cause of more controversy than the relative merits of direct and indirect lighting. The quarrel has not been merely a commercial one such as might be reasonably expected, but a technical one also, and in that aspect there is less reason for variations of opinion. A number of so-called practical studies have been made dealing with the properties of light falling directly on the page and falling upon it after reflection from the walls and ceiling, and utterly diverse data have been obtained. The probable cause of these striking discrepancies is the fact that any investigation of this sort tends to emphasize psychological rather than physical values, values therefore determinable only in vague impressions of comfort and discomfort, of ease and difficulty, of fatigue and facility.

In any tests made upon the eye other factors than the ordinary ones of shade perception and acuity of necessity enter. The particular kind of work attempted, the extent to which the several illuminations are pushed above the limit for moderate acuity, the contrast of the things observed and the length of time for which the observations may be continued, all are things which enter the final judgment as to the sufficiency of the illumination received. There is added to these causes of uncertainty a still greater one in the element of unconscious suggestion in the manner of the test or the instructions given for carrying it out. It would not be difficult to make a given group dissatisfied with almost any system of illuminaion without an expressed word of disapprobation. As a matter of fact there can be no sweeping decision between direct and indirect lighting. Some of the worst and some of the best examples of illumination alike belong to each.

### Rivalry Between Electrical Men's Own Home Equipment Good for Us All

IT IS generally agreed that the electrical man himself has been about the hardest "prospect" to interest in the use of electrical appliances in his own home. Theoretically he has believed in them from the beginning, but he has thought about them and supported them mainly during business hours. He has not tried very hard to "sell" his wife on the daily use of electricity for saving labor, and the electrical equipment of the electrical man's home has never been a beacon to the community. The action of the New York Electrical League in holding a contest among its members to determine whose house is the most completely electrified is, therefore, worthy of attention. It offers a basis for developing interest and rivalry between the men and women of any electrical group or within any electrical organization that is bound to stimulate acceptance of the responsibility which all electrical people should feel to set an example to the public in the enjoyment of and dependence upon the good things which electric service offers in the home today.

The idea was born on the special car that carried the delegates west to the N. E. L. A. Commercial Section meetings in Denver some months ago, and the "Electrify Club" was formed as an informal organization to promote contests among electrical men and bring publicity to those whose homes are well equipped. Prizes are awarded by rating houses on a point system, crediting each type of outlet and appliance, and the plan offers a spectacular demonstration of the degree to which comfort and convenience can be introduced into the modern home—electrically. Here is an idea that can profitably be furthered by the central-station company in every community.

### Noted Electrical Engineer and Motor Manufacturer Passes Away

SCHUYLER S. WHEELER, who died last week, was one of the pioneer electrical engineers of the country and throughout his entire professional life lent distinction and adornment to the profession. All that he undertook was performed with precision and thoroughness, and once convinced of the accuracy and justice of an opinion he clung to it tenaciously and fought for it with determination. Dr. Wheeler was one of those rare men who combine the knowledge and thoroughness of the engineer with the skill and executive ability of a captain of industry. Moreover, he always commanded the highest admiration because of the ethical standards on which his entire career was built.

Starting originally in the electric light and power field he engaged soon afterward in the field of electrical manufacture and was among the first in the country to recognize the necessity of a standard line of high-grade small electric motors. Owing to his accurate mechanical perceptions and creative ability, the products of his company received from the outset widespread recognition for superiority of design and efficiency. Among the outstanding electrical contributions of Dr. Wheeler to our modern civilization was the electric fan.

Professionally Dr. Wheeler always stood high. He served a term as president of the American Institute of Electrical Engineers and was the author of an engineering code of ethics which commended itself to professional men throughout the world. His keen interest in the electrical engineering profession and its traditions is evidenced by his presentation of the most complete and rare collection of electrical books in the world, the Latimer Clark library, to the American Institute of Electrical Engineers, and also by his choice of the name Ampere for the delightful industrial and residential community surrounding the works of the Crocker-Wheeler Company in New Jersey. To house the Latimer Clark libary was one of the objects which moved Andrew Carnegie to provide the funds for the Engineering Society Building in New York City.

In his dealings with men and corporations Dr. Wheeler

was absolutely fearless. He rid New York City of the labyrinth of overhead wires in the late eighties when he was expert of the Board of Electrical Control, and the utilities which then fought him have since come to honor and respect him for his fairness and the real protection which arose from his action at that time and have since surrounded the telegraph, telephone, electric and railway services of the city.

Although outwardly somewhat brusque and austere, inwardly Dr. Wheeler was a man of warm human sympathies and affections, as shown in the way he helped the maimed and blind to maintain their self-respect and to be self-supporting. His death robs the profession of one of its most verile and picturesque characters.

## Return to Private Ownership in Europe

CLOSE observation of conditions in Europe revealed hopeful signs to members of the United States Chamber of Commerce who recently went over there for that purpose. The information and the opinions presented by their spokesman, Julius H. Barnes, ought to be valuable to American business men in that they stimulate optimism and indicate that a normal Europe is within the range of vision. If ever we are to get a proper perspective of Old War conditions, it must be through American eyes. Italy Mr. Barnes considers to be "the most promising country of those in the war." Since the communistic control of industry has been destroyed by the popular Mussolini, manufacture has greatly increased. Poor Austria, the Chamber of Commerce observers find, is traveling an apparently safe road to early rehabilitation. British trade is expanding, and even in Russia commercial conditions are growing better.

Mr. Barnes recognizes as "the outstanding fact" in European conditions the tendency to get away from state ownership and operation of what he calls public facilities. "Not only," he says, "is this shown in Italy's effort to get all its public state-owned facilities in private hands, but it is shown in Austria, where there is a recasting of the government railroad service and a discharge of a hundred thousand superfluous employees. It is shown in Great Britain, where the railroads under their return to private operation have greatly quickened the business and economic life of that island and greatly improved the service and at the same time reduced the rates. It shows there is a general appreciation throughout all of Europe that these facilities must not only be in private hands, but they must be regulated so wisely that they will present a field of attraction for the superior grade of private ability to enlist itself in their administration, and that it is true that where this has been tried, as in Great Britain, they are meeting with satisfactory results."

These unofficial American observers see in all this a strong and compelling argument for the further development of public facilities in this country under private ownership but with an intelligent measure of government supervision. Facts like these ought to be brought home to every citizen at this time, when private ownership is being attacked and commission regulation scoffed at. Adversity and distress have revealed to Europe the shortcomings and fallacies of government ownership and the necessity of the stimulating and driving force inherent in private ownership. Like us, Europeans recognize that public service monopolies require regulation—a little more constructive perhaps than that experienced by the railroads—and they are preparing to follow in our footsteps, which may be regarded as a wonderful indorsement.

## A Family Triangle

OPERATING companies need trained men for subordinate positions, and also better educated professional men for positions of administrative responsibility and for those requiring advanced technical skill. It is the purpose of the trade schools to furnish training of the first kind, and it is one of the functions of high-grade universities and technical institutes of similar rank to provide men who can advance to higher positions. In this respect the two kinds of schools and the operating companies form a harmonious three-cornered family. This relationship is clearly and convincingly expounded in M. S. Sloan's article, published elsewhere in this issue, and every statement in it should be read with interest both by operating men and by teachers.

It seems much easier to establish a close relationship between the operating companies and the trade schools than between the operating companies and universities. In other words, in the family triangle the vertex which represents the institutions of higher learning seems to be quite remote from the other two vertices. Mr. Sloan desires to make the triangle more nearly equilateral through the activities of the N. E. L. A. committee on co-operation with educational institutions. This work properly conducted should prove of great benefit to all concerned.

It is refreshing to read Mr. Sloan's plea for less quantity and more quality in university training—for a training in reasoning, in observation, in service and in life problems, rather than in specific details of the electric light and power industry. This should be encouraging to faculty committees on courses, which oftentimes spend weary hours arguing how to put five gallons of information into four-gallon heads.

## The Radio Telephone in Transmission-Line Service

IN THE very interesting experiments on communication over transmission systems with the so-called "wired wireless" as a substitute for ordinary telephony, commented on recently in the ELECTRICAL WORLD, some of the weak as well as the strong points of the system have been brought to the front, the chief difficulty being that inasmuch as radio in this sense is dependent on the transmission lines and these are the usual seat of serious trouble, the power service is in an emergency very likely to take the radio service out of duty with it. Ordinarily radio transmission is at least free from entangling complications due to the power wires, but, as thousands of readers well know, it is now and then afflicted with troubles of its own. The broad question regarding the usefulness of radio on the transmission system simply resolves itself into this: Can radio distribution with a moderate amount of energy and conveniently practicable apparatus be relied upon to transmit intelligence over a radius of a hundred or two hundred miles under substantially all conditions?

It is a gratification to put on record the experience of the San Joaquin Light & Power Corporation in patiently thrashing out a solution. The full description of the sending set will well repay careful reading as it

represents the result of a great deal of experience. The main thing is that the whole set was built up of standard parts and at a total cost of only about $750, and that, working initially on a four-wire antenna 75 ft. high and 175 ft. long with a counterpoise of the same size, the sending set actually radiated 4 amp. at 360 meters wave length. When used as a broadcasting station to test its capacity, it worked clearly to stations on the Atlantic Coast more than 2,500 miles distant, and within the small radius over which it is necessary to work in transmission service there was remarkably good and regular reception everywhere. Reports even from the more distant stations showed that the volume was good and the modulation excellent. Of course, to duplicate such a system between important stations one has to adopt the usual expedient of sending at one frequency and receiving at another, the latter being the sending frequency for the duplex station and the former its receiving frequency.

It looks as if the San Joaquin experiments had reached a thoroughly practical result and had established the right of a well-planned radio system to be considered reliable. Just what difficulties may be met at times remains yet to be seen, but the results are highly encouraging. On a radio system of any kind there is not the facility for cutting in and talking back with which an ordinary telephone line is endowed, but whether in the direct-wave or free-wave form radio seems capable of fulfilling a very useful purpose in dealing with networks too large to be intrusted solely to ordinary telephony.

## New Ideas Needed on Circuit-Breaker Construction

REMARKABLE increases in the rupturing capacity of oil circuit breakers have been gained in the last few years through various improvements. However, the majority of increases in rupturing capacity have been made by increasing the dimensions or speeds of operation of the circuit breakers. As H. A. Barre, electrical engineer of the Southern California Edison Company, once expressed it, the present high-voltage circuit breakers are composed essentially of a Standard Oil tank with a wagon tongue carrying the movable contacts. The disadvantages of increasing ratings by increasing dimensions are so obvious that the engineering talent of this country should be stimulated to devise a means of performing the same results in another manner.

Just with the idea of promoting thought on the subject, it is perhaps worth while to cite one scheme proposed which, while it may not be itself the solution, may suggest other means of attacking the problem. The proposal is to build the tank for supervoltage circuit breakers below the ground level and to build it of concrete lined with sheet metal welded at the joints. There would be no stationary contacts. Each pair would be moved in a horizontal plane by a grasshopper motion. Existing improvements in circuit breakers could be made part of the plan. The results sought by this construction would be the elimination of transportation difficulties, an increase in separation of contacts, the rupturing of the arc in a position which would facilitate its extinguishment, the reduction of oil fire hazard, and possibly the reduction of oil required.

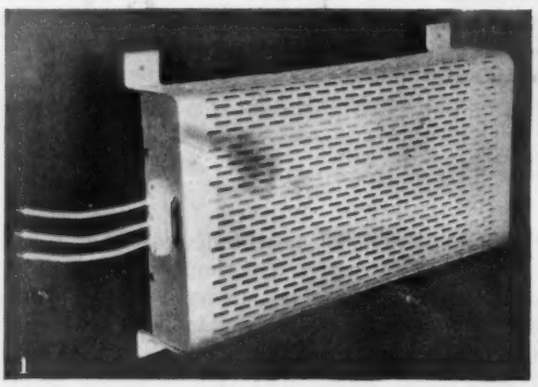
Reduction of high-potential bushings has been proposed by combining the transformers, disconnecting switches and circuit breakers in similar underground tanks separated by barriers and sealed with manhole covers. These proposals, while sounding like some of the tales of Jules Verne, will be of value if they do no more than stimulate new ideas on the construction of high-potential apparatus.

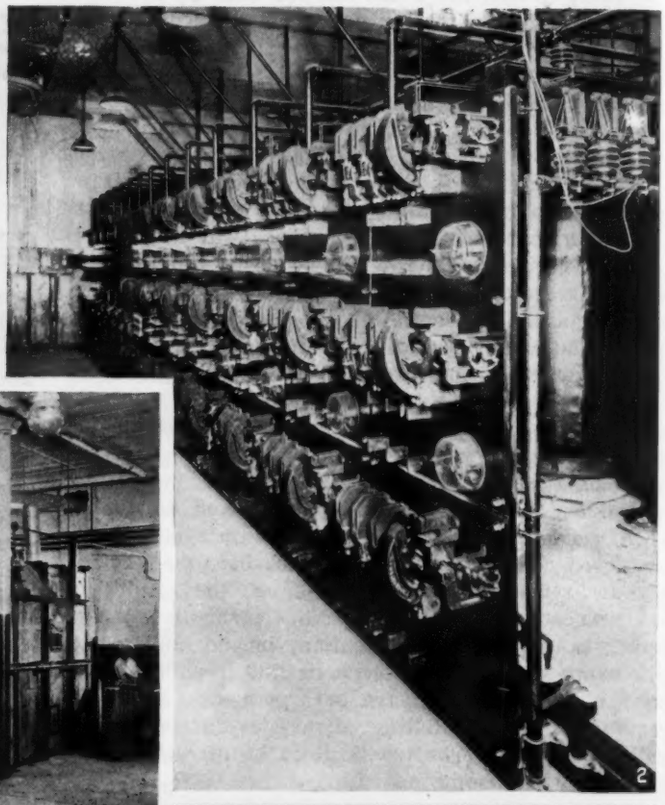
## Wider Vision Required in Regulation

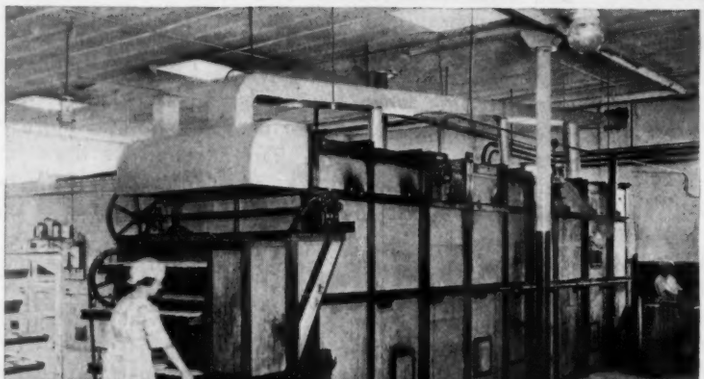
FROM time immemorial the desire for gain, whether of territory, prestige, position, fame or money, has been the impelling motive that has urged nations, communities, companies and individuals onward. Robbed of that incentive they either stand still or go backward and their contribution to society becomes nothing or less than nothing. Who cares to labor if the only compensation is a wage fixed and never increasing? Ditch diggers we must have, but even a ditch digger longs for the time when he can lay his pick and shovel by for some task less trying on his back and more remunerative in its return. To that end he does his appointed task well and fits himself for something better, and what is true of the humblest individual is true of a group or of a nation. Ambition is a natural trait, and reward usually crowns the effort of the one who succeeds at his task.

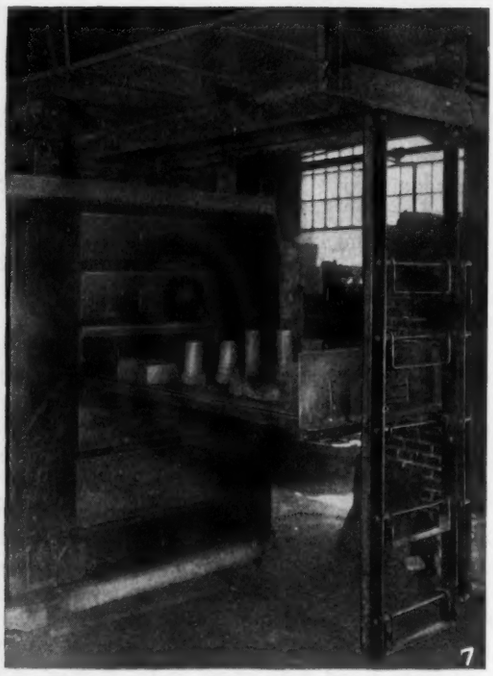
It is unfortunate that the trend of modern regulation does not take proper cognizance of this human instinct. In the desire to fix rates which are just and reasonable very little thought is given to incentives which might result in improved service. There is no fault to be found with the law; the trouble lies in its application. Courts generally recognize that the power to regulate is not a power to destroy and that limitation is not the equivalent of confiscation. But commissions are usually so engrossed and occupied on cases of the present that they have little time for consideration of the broader application of these principles and their effect in the future. Thus, whether a company exercises initiative and enterprise in the development of its territory and shows extraordinary skill and efficiency in the operation of its system or whether it does not apparently matters little. All that it is allowed is a fixed return on the investment. No distinction is made between sheep and goats. If a well-managed company, because of the exercise of extraordinary skill, succeeds in earning more than its allotted return, the surplus is virtually confiscated by the state through reduction in rates. Thus a check is placed on ambition and the exercise of initiative and enterprise is discouraged rather than encouraged. Fortunately, the electric light and power industry still takes pride in keeping its rates as low as possible, and because of higher costs of labor and material this has necessitated greater improvements in efficiency of equipment and in operation, the fruits of which have been passed on to the public. This process cannot continue indefinitely, however, and unless some reward is offered for efficiency great effort will scarcely continue to be made to attain it. The electric light and power business requires an uncommon degree of skill and experience in its conduct. It is still subject to risks, and industry, rather than make the venture itself, looks to the electric public utilities for service. Every encouragement should be given to them to expand and grow, to attract brains and capital and to help develop and perfect an art and science so universally serviceable to the race.

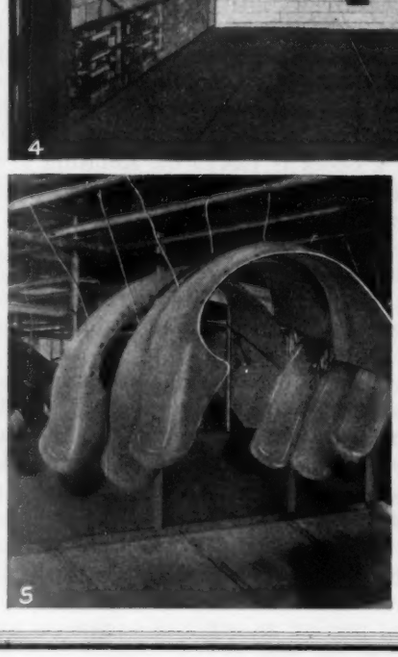
# Typical Electric Heat Applications

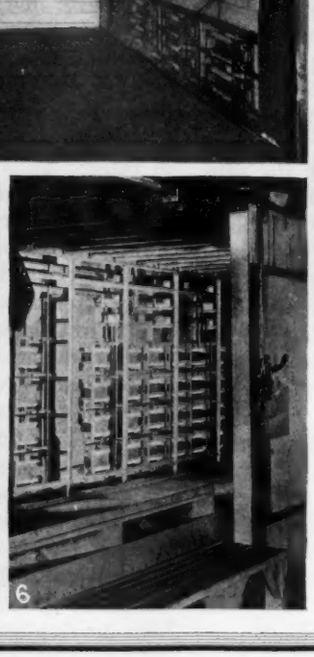












No. 1—An industrial air heater containing four 500-watt steel-clad heaters. An aluminum reflector is mounted in the rear.

No. 2—Automatic-control panels for maintaining constant temperature in an enameling oven at the Cadillac Motor Company's Detroit plant.

No. 3—A continuous-conveyor sectional type of bread-baking oven can produce more than 1,200 loaves per hour.

No. 4—A truck-type enameling oven for doors and cornice work.

Nos. 5 and 6—A semi-continuous conveyor type enameling oven at the plant of the Packard Motor Company, Detroit. At the left the fenders are shown, at right the resistors.

No. 7—A core-baking oven operates at around 400 deg. to 450 deg. F.

# To Paint or Galvanize Steel Structures?

## Results of a Questionnaire on This Debated Subject Give No Conclusive Answer—Proofs Are Not Forthcoming and Definite Data Are Few, but Positive Opinions Are Expressed by Some

IN AN attempt to answer the many questions asked about the relative merits of painting and galvanizing outdoor steel structures a questionnaire was sent to operating companies and consulting engineers. The accompanying analysis of the replies and the definite material presented should prove of value, but all the evidence shows that definite steps should be taken to obtain more accurate cost and performance data. Operating companies have kept very insufficient records on this subject, which has become increasingly important.—*Editors.*

OUTDOOR steel structures are widely used in the electrical industry, but they have been adopted so rapidly that despite this widespread employment few field data have been available on which to determine the relative merits of galvanized and painted structures of the various kinds. The experience of other industries helps little because of the distinctly different construction and application features of the structures used for electrical purposes.

For transmission-line towers and for substation structures the fabricated steel must be light and of many parts, and it must be economical as regards first cost and maintenance cost. Bridge practice and the general application of sheet steel give few data of a type which can be applied to these electrical structures, and there has been little real engineering study devoted to them by electrical engineers.

A survey of this matter in the electrical industry has brought out facts that show the existence of fields for both galvanized and painted structures. Many positive opinions have been elicited, as well as a few accurate data on installation costs, maintenance costs and length of life of the protective coating.

### ADVANTAGES AND DISADVANTAGES SUMMARIZED

A summary of the advantages of the galvanized structure may be thus given:

1. Where parts of the structure are not readily accessible or dangerous to life—for example, near live wires—galvanizing has advantages.

2. Where the structures are widely scattered and the cost of a careful inspection would be heavy, galvanizing is also advantageous.

3. Where a permanent installation of sufficient magnitude to warrant a company doing its own galvanizing is made, the cost of galvanizing adds only 20 to 30 per cent to the cost of the steel.

4. In fabricated structures where bolts are used galvanized parts have a longer life.

5. In some structures it is possible to use lighter steel if it is galvanized than if paint is used. For example, one company reports that galvanizing increases the cost about a third, but permits the use of $\frac{1}{8}$-in. angles as compared with the $\frac{3}{16}$-in. angles required for painted structures.

6. The length of life of the galvanizing is from eight to fifteen years as compared with two to four years for paint.

The disadvantages of galvanized structures are:

1. First cost is high—reports give figures varying from 30 per cent greater to nine times the cost of painting.

2. The quality of galvanizing varies, necessitating rigid specifications.

3. In certain locations—for example, in a damp, salty atmosphere and in a sulphur-laden atmosphere—galvanizing has a very short life, so that its application is somewhat limited.

The advocates of painted structures are rather numerous, particularly where certain types of structures are concerned. Certain of the advantages of painting are:

1. It is cheaper than galvanizing, and this makes it particularly advantageous for new installations in which the capital charge must be kept low until the load grows.

2. It costs little to have painting done by the normal line crew during odd moments.

3. Paint of different qualities can be found suited to peculiarities of the location of each structure as regard weather conditions, air conditions and a changeable environment.

On the other hand, paint has some disadvantages, for:

1. It is difficult to obtain paint of the proper quality for each application.

2. Two or more kinds of paint must be used to obtain good results.

3. Repainting must occur in from two to four years, and in many cases this is a very costly operation, particularly if structures are brushed or scraped before repainting.

4. Repainting of live structures is hazardous and it is difficult to "kill" substations or lines.

Several companies state that their practice is to use both galvanized and painted structures. For tower lines galvanizing is generally preferred, but under special conditions painted towers are used and very frequently the bus structures, arrester tanks and breaker tanks are painted. Nearly all say that the quality of the galvanizing and of the paint is very important. A wide variety of choice in paints is found, with a red-lead base and aluminum top coat in general favor.

### VARIATION IN COSTS

One company reports the cost of painting a steel-tower line installed in 1916 as $8.95 for labor and $1.42 for paint per tower, or about $1.50 and 24 cents per tower-year respectively. Another company gives the cost of painting as $\frac{1}{2}$ cent per pound of steel painted, while the cost of galvanizing is 1 cent a pound or higher, depending on the tonnage of the order.

It is rather difficult to make positive deductions from reading the various answers, but a consensus of opinion exists to the effect that galvanizing can be used advantageously for transmission-line structures and isolated substation structures where these are just outside of

more or less thickly populated sections. Galvanizing also has advantages over painting for parts of switching structures which are rather inaccessible because of the proximity of live parts which cannot be "killed." If such structures are exposed to acids or fumes, extra-heavy galvanizing should be specified and paint put on the galvanizing after it has weathered better to protect it from fumes.

For all other structures painting seems to be as satisfactory a method for protecting steel as can be obtained, provided that a first-class paint is selected. suited to the purpose for which it is used, and that at least three coats of the paint are properly applied. Skilled painters should do the work if a good job is to be obtained.

In order to report the conditions ascertained more definitely a selected list of companies and the statements made by their representatives are given below. It is hoped that a more thorough investigation of the subject will be undertaken by the industry and that field records will be kept by companies located in widely scattered locations.

## Opinions from Users of Outdoor Steel

### Connecticut Light & Power Company
Waterbury, Conn.

We have not made any extensive tests to determine the relative final cost of galvanizing versus painting. We have used different kinds of paints for some years and have come to some very definite conclusions as to the value of different paints under different conditions.

As far as galvanizing is concerned, it is our general policy to galvanize all such parts of steel structures as after erection are not readily accessible on account of their close proximity to live parts of conductors and equipment. This refers to steel used in outdoor substation work. On line towers and other steel structures we are using, wherever possible, galvanized iron, because part of the structure is not readily accessible for painting on account of proximity to live parts, and because on the whole the structures are scattered so far that a painting job would be expensive. Moreover, the close supervision necessary to determine when painting is required would add materially to the cost of inspecting the line. Of course, there is always a chance of rust, even with galvanizing. However, rusting does not progress very rapidly, and very infrequent inspections will be sufficient to discover it and to permit taking the necessary steps to arrest it.

As far as the painting is concerned, we first used a red lead and various paints on top of it as a second and third coat, some dark green and others battleship gray. We even tried some of the heavy black compound paints in an endeavor to obtain a paint that would last some time. As a rule we found that we could not let painting go more than three years at the most without considerable rusting taking place. This refers particularly to Waterbury, where the conditions may, of course, be more severe on account of the close proximity of a spray cooling system. We accidentally started to use the paint which is now our standard, namely, the aluminum paint. We first used it in New Britain, where we were installing the first outdoor station, using galvanized trusses, but painting posts so that a post should as nearly as possible look like the truss—therefore the aluminum paint.

We first mixed this aluminum paint with banana oil. The experience was most discouraging, because the paint was flaky and did not last very long. After considerable experimenting we were finally advised by a paint manufacturer to use the following mixture: 1 lb. of powder aluminum paint to 2 qt. of Sipes "bronze liquid." Ever since we have done this the results have been most encouraging. As a matter of fact, they have been so encouraging that we have standardized on the aluminum paint not only for the steel structures but also for the circuit-breaker tanks, lightning-arrester tanks and rain shields (O. F. arresters) and power transformer tanks.

It was about three years ago that we started to use the new mixture for the aluminum paint, and the parts painted since do not show any signs yet of needing repainting. Just how long we can go without repainting I am unable to tell at this time. E. J. AMBERG,
*Electrical Engineer.*

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### Cumberland County Power & Light Company
Portland, Me.

All our outdoor steel structures are painted. Our Hiram transmission line, approximately 15 miles long, is a tower line of A frames and rigid towers. This was placed in service in 1916 and was painted this year at a cost of $8.95 per tower. The original paint was so-called "Carbon Elastic." This year we used "Valdura," which is practically all "Gilsonite." The price of $8.95 is for labor only and this represents a cost of about $1.50 per tower per year. The cost of the material used amounted to $1.42 per tower, or at the rate of about 24 cents per tower per year.

GEORGE E. HAGGAS,
*Chief Engineer.*

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### Public Service Production Company
Newark, N. J.

All our outdoor steel structures are painted. We have used no galvanized structures to date. We have no data as to the average life of protective coating, but our practice is to use the best grade of paint and repaint structures about every two years. As to kinds of paint, we have had satisfactory results using Patton's "Iron Hide," Suydam's "Dock Department" paint and "De-re-ko."

We have no data showing the cost of painting based on the life of protective covering. Our climatic conditions are bad on account of salt air and acid fumes. We do not believe that galvanizing would provide a complete protection unless members were double galvanized. Even in this case, structures would have to be painted after 5 or 6 years use. E. B. MEYER,
*Chief Engineer.*

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### Niagara, Lockport & Ontario Power Company
Buffalo

I am sorry that I cannot give you any exact dollars-and-cents figures which will support our decision in favor of painted instead of galvanized transmission structures for our recent order, but I can state some of the general considerations which have led to this policy at the present time.

We installed in 1905-1906 more than a thousand towers of each type. The painted towers have been repainted approximately every four years. Some of the galvanized towers erected near the industrial centers or near railroad right-of-way, where they are exposed to gases and smoke, showed serious impairment of the galvanized protection after seven years of service, although others, erected in the open country, are still in fairly good condition. I believe, however, that I can conservatively state that all structures in the vicinity of railroad right-of-way and in the outskirts of settled communities were badly in need of repainting after ten years of service. For such towers, therefore, the saving effected by galvanized structures is roughly represented by the cost of two and one-half repainting jobs. In computing the cost of such repainting jobs a very substantial credit should be made on the cost of labor, because this work can be done by the regular line organization at odd times when there is no need for their services on other maintenance or emergency work. It should also be considered that the first painting job on a galvanized tower after rusting has started in is considerably more than the repainting of a well-painted structure. We have also found that there is a good deal of difference in the durability of different galvanized structures, sometimes from the same firm but manufactured at a different date. Such difference could possibly be avoided by more rigid inspection, but a rigid inspection of the galvanizing of all tower parts is necessarily very expensive and would add materially to the cost of galvanized structures. It is, therefore, our judgment that for our lines in western New York, which parallel and frequently

run adjacent to railroad rights-of-way and through the outskirts of several industrial communities, the painted structure is better adapted; but if we had to build a line in open country, free from gases and fumes, we should probably favor galvanized construction.

It also should be considered that the expense of a transmission company is necessarily represented to a very large extent by fixed charges on investment, which cannot be adjusted to changes in earnings, whereas maintenance can always be somewhat synchronized with the earning situation, increased in good times and curtailed when earnings fall off. In spite of the fact that fixed charges on the additional cost of galvanized structures may be less than the average cost of repainting structures during the first ten or fifteen years, it may be better policy to keep down the initial investment for the reasons stated before and also because in most cases it is not possible to show a profitable return from the initial business reached by any new extension, whereas the future growth of this business is usually sufficient to earn eventually a profitable return and increased maintenance charges. I am not sure whether at the present time this relation still obtains, but not so long ago we found that increasing the thickness of all parts of a transmission structure by ⅛ in. did cost less than the galvanizing of the lesser thickness of metal. This, of course, raises the question whether ⅛-in additional metal is not a better protection than the thin galvanized coating. S. PIEK,
*General Manager.*

**East Massachusetts Electric Company**
Salem, Mass.

We use only painted outdoor steel structures and get an average life of about two years for the protective coating. We have no definite cost figures, but we repaint every two years with graphite paint. H. G. JENKS,
*General Superintendent.*

**Narragansett Electric Lighting Company**
Providence

We have but few steel structures, but those we have are not galvanized and, owing to the fact that they are built near the salt water where dampness and frequent fogs prevail, it is essential that they be covered each year with a protective paint.
W. T. OVIATT,
*General Superintendent.*

**Central Maine Power Company**
Augusta, Me.

Our outdoor steel structures are painted, the average life of the paint being three years. We have had no experience with galvanized-steel structures. No data are available for the cost of painting. We have very few of these structures and so have not gone very carefully into the cost of maintenance and upkeep of the same.
GEORGE S. WILLIAMS,
*General Superintendent.*

**Indianapolis Light & Heat Company**
Indianapolis

We have just recently started high-tension outdoor substation construction. Most of our substations are made from 2-in. galvanized pipe and fittings. We have some painted structures also made from Bates steel poles. I have no exact data on the length of time either method will last, but I will say that neither seems to hold up very well for us. The painted structures should really be painted every two years.

We seem to have more trouble with galvanizing on the bolts than we do on the pipe itself. We have several small home-made fittings installed on these stations which were dipped in red lead and then painted with aluminum paint. I do not know just what the cost of this would be if it were done on a large scale, but I am sure it will last twice as long as ordinary galvanizing, judging from our experience in the past two or three years. E. G. RALSTON,
*Chief Electrical Engineer.*

**Northern States Power Company**
Minneapolis

We have on our system several hundred miles of high-tension steel tower or pole-line construction, also innumerable steel-skeleton frame outdoor substations, special switching towers and heavy long-span river and valley crossing towers.

On many of these, erected some time ago, we were unable to obtain galvanizing, as the manufacturers did not have tanks long enough to take the larger members. Of late years, however, many large hot-galvanizing plants have been installed. (One which I know of can take an entire 35-ft. expanded pole section in one dip.) It is therefore now relatively easy to get hot-galvanized outdoor steel members of almost any size.

Hot galvanizing can be regarded as a permanent investment. Our experience has shown that in our climate, remote from salt air, it will last almost indefinitely. The approximate added cost for such galvanizing runs from 15 to 20 per cent of total cost, so that the fixed charges on this extra investment can be balanced against cost of periodic painting. On this basis of comparison galvanizing will nearly always win out on a dollars-and-cents basis.

On outdoor electrical structures in general the electrical equipment must be kept alive at all times. This means painting around live equipment and wires and requires a skilled electrical worker with a knowledge of painting methods—a combination not always easy to find.

Where painting is used for protective purposes it must be carefully watched and repainted before rust sets in. On one of our long transmission lines we were forced by war-time conditions to miss one periodic repainting schedule. When we finally got around to the work we had to scratch-brush every tower, and the repainting cost probably exceeded what would have been paid for hot galvanizing could it have been obtained when these towers were fabricated.

The selection of suitable paint is a problem too deep for the average central-station engineer and further complicated by the fact that a really good paint may give poor service if improperly applied. Most of us fall back on the old rule for selecting a strictly fresh egg—break it open and judge by the smell. In other words, if the paint used gives long service, it is good, otherwise not. In either event we have spent our money to find out.

Our chemical laboratory has recently made exhaustive tests and experiments on paints for various classes of service, and we now have standard paints made to our own special formulas. Even with these we never paint outdoor steel if it is practicable to get it galvanized. On all outdoor hardware and standard fittings, including substation frames, standard towers, etc., we have a standing rule that the workman must not take them out of the storeroom unless they are galvanized, except where order specifically calls for ungalvanized stock. S. B. HOOD,
*Superintendent of Distribution.*

**Public Service Company of Northern Illinois**
Chicago

We have very little definite information on this matter, but consider galvanizing to be more satisfactory than paint. We have a few galvanized towers which have been in service for about ten years without painting and which are just beginning to show signs of slight rust. We have several outdoor steel substation structures which were painted. The paint on them does not seem to stand up for more than about two years. D. A. PIERCE,
*Engineer of Electrical Distribution.*

**Twin State Gas & Electric Company**
Boston

We specify galvanized steel for outdoor substations. Our operations have not to date given us any definite idea as to the probable average life or definite cost data.

Our climatic conditions are rather severe. In one of our localities structures are exposed to some spray from salt water. Galvanizing is in accordance with standard galvanized specifications. Bolt holes are drilled and tapped before galvanizing.
R. J. ANDRUS.

**Scofield Engineering Company**
Philadelphia

Regarding the merits of galvanizing and painting for the protection of outdoor steel structures, we believe there is no question that under most conditions galvanizing is very much more effective.

The average life of protective coating naturally varies widely, depending on the coating and the conditions. For instance, we have had cases where galvanized corrugated sheets have been in position for twenty years without any

apparent deterioration and other cases where such sheets have deteriorated to a point necessitating renewal in ten years or even much less.

Painting of steel structures is ordinarily required every two or three years, and there are some conditions where painting yearly is necessary to secure any adequate protection.

As a general rule, we should say that galvanizing was cheaper than painting in the long run for thin sheets and shapes where any serious damage to the metal requires immediate replacement, and that painting is probably cheaper on heavier structures where a slight amount of corrosion under painting does not seriously endanger the structure.

F. DAUGHERTY,
*Vice-President.*

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**Wisconsin River Power Company**
Madison, Wis.

We use both galvanized and painted outdoor structures. We have galvanized structures in good shape after twelve years; paint lasts about four years. During the war the cost of galvanizing was high, but now it is cheaper to buy galvanized steel. Our temperature ranges from — 30 deg. F. to + 98 deg. F. with a rainfall of about 30 in.

G. C. NEFF,
*General Superintendent.*

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**Pennsylvania Power & Light Company**
Allentown, Pa.

We use both galvanizing and painting material on outdoor steel structures. On transmission towers and switching towers we standardize on galvanized material.

Galvanized transmission towers and switching structures have shown no depreciation in ten years except in isolated cases. Painted structures have had to be repainted in from one to five years, according to local conditions.

No comparative data can be given as to the cost of galvanizing or painting based on the life of protective covering, as this varies very greatly on painted structures, while on the galvanized structures there has been practically no deterioration. We have had one galvanized transmission tower out of approximately a thousand which has shown deterioration due to heavy sulphur conditions. Several galvanized towers in culm banks have also rusted at the ground line and have had to be concreted. These are unusual sulphur conditions, however, and isolated cases exist among both painted and galvanized structures of excessive deterioration. However, in ten years there has been no deterioration in galvanized structures where the galvanizing has been satisfactorily done.

The following data give an idea of operating conditions:

Average rainfall, 45 in.; snow and sleet during winter months; heavy lightning storms in summer; temperature range, — 15 deg. + 90 deg.

Frequency of painting is dependent on local conditions and quality of original painting. Normally, steel structures have to be repainted in about three years. Where painting has started to scale and rust it is wire-brushed and red lead or red oxide paint is first used. A carbon paint is used for the finishing coat. Galvanizing is done according to N.E.L.A. specifications or those of the Electric Bond & Share Company of New York.

A special condition affecting the life of galvanizing is the presence of sulphur fumes from coal. This has affected structures where conditions have been very extreme and steel surrounded by heavy coal smoke. In coal-culm piles at the ground line galvanizing has deteriorated. In regard to painting, the quality of the original preparation of the steel, the manner of applying the paint and weather conditions at the time of painting very materially affect its life.

ALEXANDER COLT,
*Superintendent of Transmission.*

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**Southern California Edison Company**
Los Angeles, Cal.

All of our steel structures, such as transmission-line towers, steel framework for outdoor substations, latticed steel poles and work of that type, are galvanized and not painted. It is hard to tell what the average life of this galvanizing is. We have some structures that have been in use for twenty years that are still in good condition. We have found, however, that in certain localities where the galvanized steel is buried in alkaline soil the galvanizing is being attacked and the steel will clearly have to be replaced. This condition has been noted on the Big Creek line, which is now seven or eight years old; I believe in some instances the galvanizing has disappeared, although the steel has not yet been attacked very badly.

We have constructed many buildings of galvanized corrugated iron, and find it is best to paint this galvanizing after it has been weathered for a few months. The galvanized sheet iron that is purchased in the open market is of rather poor quality and does not seem to be equal to the heavier galvanized sections that are used in steel towers, etc.

H. L. DOOLITTLE,
*Assistant Construction Engineer.*

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**San Joaquin Light & Power Corporation**
Fresno, Cal.

The question of galvanizing has received considerable consideration from us. Galvanizing is sometimes a large item of expense, and it can be carried to extremes. For instance, material which is satisfactory in a climate such as exists in the central portion of the state would be very unsatisfactory in sections subjected to a great deal of dampness and sea fogs, etc. Material used in the San Joaquin Valley would not stand up when exposed to atmospheric conditions such as exist in the counties on the coast.

All towers which we have purchased, whether for use in the valley or on the coast, are galvanized. Towers such as are used in substation yards to carry high-tension buses are painted. We find that it becomes necessary to repaint these towers about every three years. The galvanizing, if properly applied, will last much longer than that. The cost of galvanizing adds about 15 to 20 per cent to the original cost of the metal.

In the San Joaquin Valley we do not use any galvanized pole-line hardware with the exception of the hooks and eyes, etc., which are used with suspension-type insulators. Our cross-arm braces, bolts, etc., are plain black iron. This climate is very dry, while in Santa Barbara, San Luis Obispo and Monterey Counties the climate is much damper. In these counties we use galvanized hardware throughout.

Our specifications on sheets for corrugated iron buildings is as follows: "Galvanizing on sheets furnished under this proposal must show a uniform surface, clean and smooth throughout and must weigh not less than 1.2 oz. on each side per square foot of area treated, and the lightest spot on any sheet must not fall below the above stipulated minimum."

I might add in conclusion that in my opinion galvanizing is a necessity in most climates, but we have found that in the San Joaquin Valley plain black iron will outlast other material which enters into the construction of a pole line.

E. A. QUINN,
*General Superintendent.*

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**Kansas City Power & Light Company**
Kansas City, Mo.

We are using both galvanized and painted outdoor steel structures. We use the painted structures in some localities, such as isolated outdoor steel substations or places where the ground is high and there is not so much smoke as occurs in railroad districts. We find that two coats of paint—the first coat, say, of red lead and the second coat of carbon paint—will last two or three years. Paint on structural steel at lower elevations and in districts where there is a considerable amount of smoke from industries and railroads will barely last a year.

We find the cold process of galvanizing such as has been used around Kansas City unsatisfactory. Some of it showed evidences of rusting after a week. Hot-dip galvanizing, we have found, will last five years or more without any evidence of deterioration. This again, however, depends entirely on the location of the structure. We have no definite cost data on a comparative basis.

Our summers are rather warm and dry. In the fall, starting about the first of October, there is no wind, which tends to keep all of the impurities of the air near the ground. This seems to be the most severe condition of the year. Our winters usually are fairly mild. In general, I would not consider the climatic conditions very severe on the structural steel work.

We have had occasion to observe the difference in results between the use of graphite paint and of a carbon paint. There are several large oil

tanks along the river where the most severe condition that we have in our district exists, and we find that after one year's time the graphite paint shows a complete loss while the carbon paint shows no evidence of losing its value. These tanks are in a district where there are smoke and fogs from the river. A. E. BETTIS,
*Superintendent of Distribution.*

### New England Power Company
Worcester, Mass.

It has been our practice during the last few years to galvanize all steel used on transmission lines. However, we have painted a great many of our steel structures for outdoor substations. The average life of the protective coat of paint is about three to four years. We have to date noticed no deterioration in galvanized structures, some in service fourteen years.

The cost of original painting and subsequent painting averages about ½ cent per pound of steel painted. The cost of galvanizing runs from 1 cent a pound up, depending on the tonnage of the individual orders.

Our system covers a large part of the central portion of New England, extending from Bellows Falls to the coast at Providence and Fall River. We have noticed no difference in deterioration on any part of the system to date.

It is necessary to paint steel structures every three or four years. This we do by scraping off all rust, following this by a protective coat of red lead on the scraped portion of the steel and then by a color coat over the whole structure. All our galvanizing has been done under the standard "B" specifications. C. R. OLIVER,
*Assistant General Manager.*

### Turners Falls Power & Electric Company
Greenfield, Mass.

We have had experience with both painted and galvanized structures and recommend galvanized structures wherever bolted connections are allowed. On railroad crossings where riveted connections are made we use painted structures. Galvanizing in Seekonk and Somerset, Mass., on windmills is in good condition after twenty-five years. Painting is required about every three years where such structures are used.

Galvanizing increases the cost of the steel about 33⅓ per cent, but this is offset by the fact that we can use ½-in. angles while painted structures use ⅝-in. angles as a minimum. The cost of two field coats of paint is roughly $35 per ton.

We have a temperature range from — 20 deg. to + 90 deg. F. with high humidity, inland location and altitude from 50 ft. to 2,000 ft.

We use on our painted structures originally one shop and two field coats and repaint about every three years. Repairs consist of spot red oxide and one coat of paint (we have experimented with various kinds). Coal gas, salt water and acid fumes seriously affect painting. Galvanizing is done in accord with American Telephone & Telegraph Company specifications.
H. D. SEAVEY,
*Superintendent of Distribution.*

### Oklahoma Gas & Electric Company
Oklahoma City, Okla.

We use both painted and galvanized outdoor structures. The average painted structure must be repainted about every two years. We have no definite data on the life of galvanizing. Our summers are rather warm with winters typical of the Southwest. All painted steel work receives one coat of graphite paint and two coats of aluminum paint when first installed, then each two years one coat of aluminum paint only is used. J. M. BROWN,
*Superintendent of Distribution.*

### The California Oregon Power Company
Medford, Ore.

As far as line hardware and substation structures and power-house buildings are concerned, we use galvanizing instead of painting. We do not have sufficient data at hand to determine average life of this coating.

Climatic conditions in our territory are generally favorable to a long life for steel structures. The precipitation is in general light, the altitude comparatively high, and we do not have the salt atmosphere which causes deterioration of steel structures along the coast. The only data which we have in this connection are in regard to steel penstock pipes. We have a pipe line installed in 1903 and coated with an asphaltic dip. This coating is still in very good condition. We have another pipe line painted in 1912 with graphite paint, and this also appears to be in good condition. The steel pipe on Unit No. 1 of our Copco installation was painted in 1917 with a bitumastic paint, and we are at present repainting this pipe, although it is not in very bad condition. C. E. BLEE,
*Assistant Engineer.*

### Puget Sound Power & Light Company
Seattle, Wash.

We use both galvanized and ungalvanized steel structures. The average life of the galvanized is rather uncertain and depends upon the character of the original paint, the method of handling during construction and the amount of fitting and damage done during construction.

The average life of galvanized structures could be taken as about nine or ten years; the life of protective paints, if a good type of paint is used and properly applied, could be taken as about five years. We have some steel towers in the vicinity of a smelter where galvanizing lasted only about a year and acid-proof paint coatings lasted only from one to two years.

The cost of galvanizing as compared with painting on steel towers is about nine times that of painting. I have no data on the comparative costs of galvanizing and of painting sheet-metal structures.

Our climate is damp with a good deal of salt air near the coast, and all painted structures are repainted about every four or five years. All galvanized structures should be inspected once a year for rust spots, and these should be thoroughly cleaned and a protective paint applied. S. C. LINDSAY,
*Engineer.*

### New Bedford Gas & Edison Light Company
New Bedford, Mass.

We cannot give you any accurate data on the relative merits of galvanized and painted structures. Though we have both types of structures in and about our plant under varying degrees of exposure to weather and salt fogs, we have not made a record of the results obtained. We have some galvanized structures quite near the seacoast, and also painted structures, but no satisfactory statement can be made regarding their relative merits as regards the protection of the iron.
DAVID W. BEAMAN,
*Supt. Electrical Department.*

### United Hudson Electric Corporation
Poughkeepsie, N. Y

Most of the outdoor substation structures erected during the past three years have been galvanized. The few exceptions that have been painted during this period already need repainting. Prior to 1920 all such structures were painted. All transmission-line towers are galvanized with the exception of a few narrow-based steel poles erected about five years ago, which are painted with a shop coat of red lead and linseed oil and a field coat of black graphite paint.

The average life of paint as an effective protective coating on outdoor substations is about three years. Generally speaking, the use of galvanizing as a protective coating is of such recent practice with this company that no statement of its life can be made. However, galvanized transmission towers in service since 1917 are today apparently as good as new. Ground-wire bayonets, composed of 2½-in. x 2½-in. x ⅜-in. angles, galvanized about ten or twelve years ago are still in excellent condition. The expectation is that galvanizing as compared with painting will justify itself in about six years.

Climatic conditions are not unusually severe. Most fogs are fresh mountain mists, and it is doubtful if any of the salt fogs of the coast reach this territory. Very little trouble from industrial fumes is experienced. The worst conditions are in cases where the towers cross or parallel railroads, and these cases are causing no trouble.

Painting of outdoor substation structures is done about once every three years. The paint used is generally of lead or graphite pigment with linseed oil, though no standard practice has been developed. Galvanizing is in accordance with N. E. L. A. specifications.
E. A. VAN DEUSEN,
*Assistant Structural Engineer.*

# Line Regulation and Power Factor Correction

## Effect of Line Voltage Changes on Loads of Various Kinds, Particularly Those Arising with the Employment of Power-Factor Corrective Devices

By Clifford W. Bates
Research Engineer, Philadelphia Electric Company

When considering the installation of condensers to improve the power factor of a system, it is important to consider the effect of voltage variation on the amount of correction obtained, particularly as the effect is quite different on the two available types of apparatus in use—the static condenser and the so-called synchronous condenser. It is also interesting to note the effect of voltage variations on the input to loads of various kinds.

The static condenser behaves exactly like a resistance of any type, such as lights, heating devices, etc.; that is, the current is directly proportional to the voltage and the kva. input or kw. input in the case of heating devices is proportional to the square of the voltage.

Synchronous condensers, on the other hand, being essentially synchronous motors operated at no load with the field overexcited, behave very differently. If the line voltage increases with the excitation remaining the same, the current and kva. input fall, since the increase of voltage is equivalent to a relative decrease of overexcitation. In fact, if the line voltage should increase so as to equal the voltage to which the motor is excited, the current would be reduced to zero, except for the small power component necessary to drive the motor, and a further increase would result in a lagging current. A decrease in line voltage operates in exactly the opposite way, as this is equivalent to a relative increase in the overexcitation. The magnitude of the change depends to some extent on the design of the condenser. The curves given in the analysis correspond to a motor having 50 per cent synchronous impedance.

Induction motors vary considerably in their characteristics, depending principally on the type (squirrel-cage or wound-rotor) and on the size. The curves of Figs. 1 and 2 are based on a 20-hp. squirrel-cage induction motor of average characteristics. They are based on constant torque duty, such as driving machine tools and hoists, but the values were calculated for the motor driving a fan, for which the torque varies as the square of the speed, and are found to differ very little from the constant-torque values for the range of voltage variation included by these curves.

The very small change in the power input to induction motors as the motor voltage varies from 20 per cent below to 20 per cent above normal is particularly striking. This is mainly due to the fact that the speed change is comparatively small within this range, and that any variation of power taken by the load from the motor depends on the speed. Although the output does decrease slightly because of reduced speed the losses increase in such a way as practically to neutralize this decrease. The reactive component, on the contrary, decreases rapidly with a decrease of voltage.

In the case of synchronous motors the power output is independent of voltage variations and the power input is virtually so. The power component of the current will then vary in inverse proportion with the voltage. The reactive component will vary in general like that of a synchronous condenser.

### Conclusions

The curves show that the synchronous condenser is more effective under variable voltage conditions than the static condenser. The correction afforded by the static condenser tends to decrease at the very time when it is needed most, while that given by the synchronous condenser increases even more rapidly than the voltage decreases, thus automatically compensating to some extent for the drop in voltage, particularly if this drop be due to a heavy overload at low power factor. However, the use of static condensers should not be entirely condemned as their relatively lower losses, the decrease in amount of attendance necessary and their smaller bulk, together with their lower cost in the small sizes, may often result in a static condenser being installed for correction purposes in a location where no condenser would be installed if the synchronous condenser were the only type available.

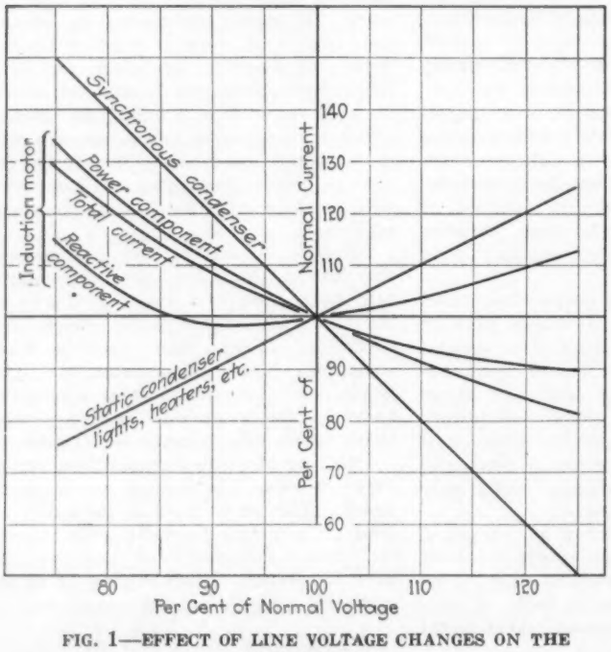



FIG. 1—EFFECT OF LINE VOLTAGE CHANGES ON THE CURRENT INPUT

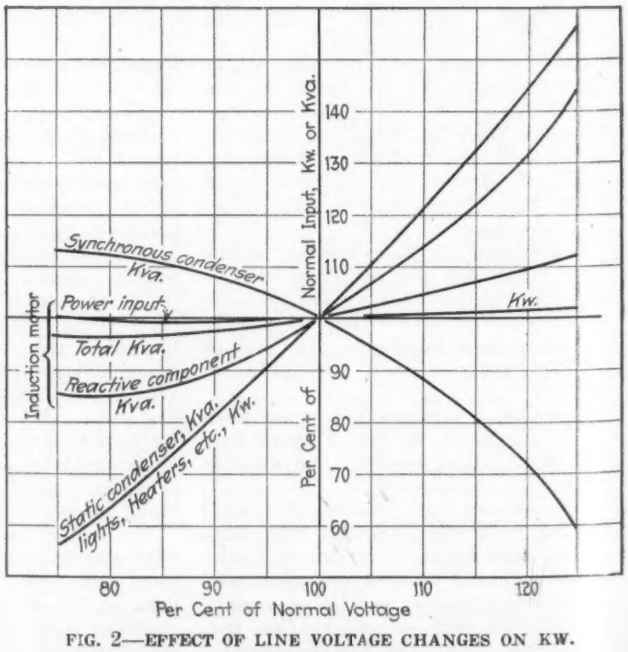



FIG. 2—EFFECT OF LINE VOLTAGE CHANGES ON KW. AND KVA. INPUT

# Industrial Electric Heat Applications—I*

## A General Résumé of Industrial Heating-Oven Practice—The Solution of the Control Problem and Limitations in Furnace Applications—Different Types of Furnaces in Use

By J. L. McK. YARDLEY
*General Engineer Westinghouse Electric & Manufacturing Company*

IT IS difficult to astonish any one with the achievements in any branch of the electrical industry. Frequently a sprout from the parent tree has grown unnoticed until it has acquired a magnitude that compels comment. In fact, the tendency now is to heap public encomiums on everything accomplished electrically, independently of comparative merit.

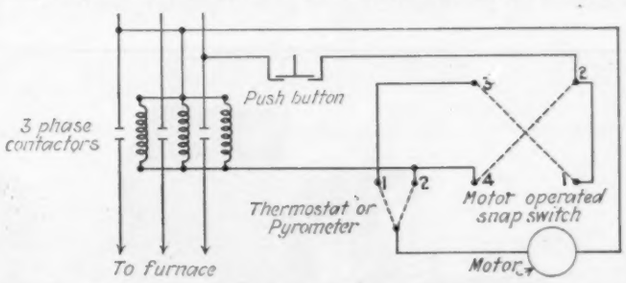
One of the most recent activities of the electrical industry is connected with the electric furnace or oven and its application to industrial heating purposes. In the face of fierce competition this activity has won a secure place and has an encouraging outlook. Yet the art is not sufficiently advanced or the economical situation sufficiently sound to warrant predictions to the effect that it will or even should be the universal agency for industrial heating. Each application and industry affords a specific occasion for engineering and economic analysis before a decision can be rendered intelligently.

It seems unquestionable that the field of industrial heating by electricity will expand greatly, owing to the abundance, cheapness and reliability of electric power and to the superior results of one kind or another which are often experienced. Because of these results it will extend particularly and quickly in the industries in which it has already started. The other industries and new applications must be approached by experts capable of applying both economics and science with good judgment to the problem.

Many improvements are being and will be made in fuel-fired furnaces to meet the competition of electric furnaces. Much of the improved thermal efficiency of the electric furnace attained by the use of large quantities of improved heat-insulation materials may also be attained with fuel-fired furnaces, the design of which has been improved to include similar qualities of the same insulation materials. The essential factor is that in industry, in the final analysis, the foremost consideration is over-all cost. Another point to consider frankly is that whereas, theoretically, the atmosphere in the electric furnace chamber may be whatever is desired, practically, using the metallic resistor furnace, it is exceedingly difficult to have anything but a somewhat oxidizing atmosphere in the furnace chamber. This fact makes some process applications, as, for example, the bright annealing of steel, formidable problems for the electric furnace, such as can be and will be worked out only by experts.

The industrial oven or furnace, of course, consists essentially of some electrical resistor material and some heat-insulation material carried in a metal frame for mechanical support. Many kinds, types and varieties have been produced. The fundamental material is the resistor, and the table shows some of the kinds now used or suggested for use in industrial furnaces.

The heat insulation materials have gained great prominence in recent days, because they directly affect the thermal efficiency of the oven. There are a great many materials used commercially, such, for example, as (1) mineral wool, which is a product of silica, alumina and iron oxide, made by blowing a powerful jet of air or steam through blast furnace slag, and (2) insulating bricks of various kinds, such as "Sil-O-Cel," "Insulbrix" and "Nonpareil." As refractories, or material that is close to the heating elements in




SCHEMATIC DIAGRAM OF THERMOSTATIC OR PYROMETER CONTROL OF CONTACTORS FOR INDUSTRIAL OVENS

The thermostat is at 1 and the motor switch at 4-2. To start the furnace the push-button is closed, closing the control circuit through the coils of the contactor, which then closes and connects power to the resistors. When the furnace reaches a predetermined temperature the thermostat makes contact at 2 and closes the circuit through the motor-operated snap switch, which moves to position 1-3. This breaks the contactor-coil circuits, opens the contactors and opens the circuit of the motor-operated switch. As the furnace cools the thermostat goes back to position 1, which causes the motor switch to return to position 4-2. The angle then repeats itself.

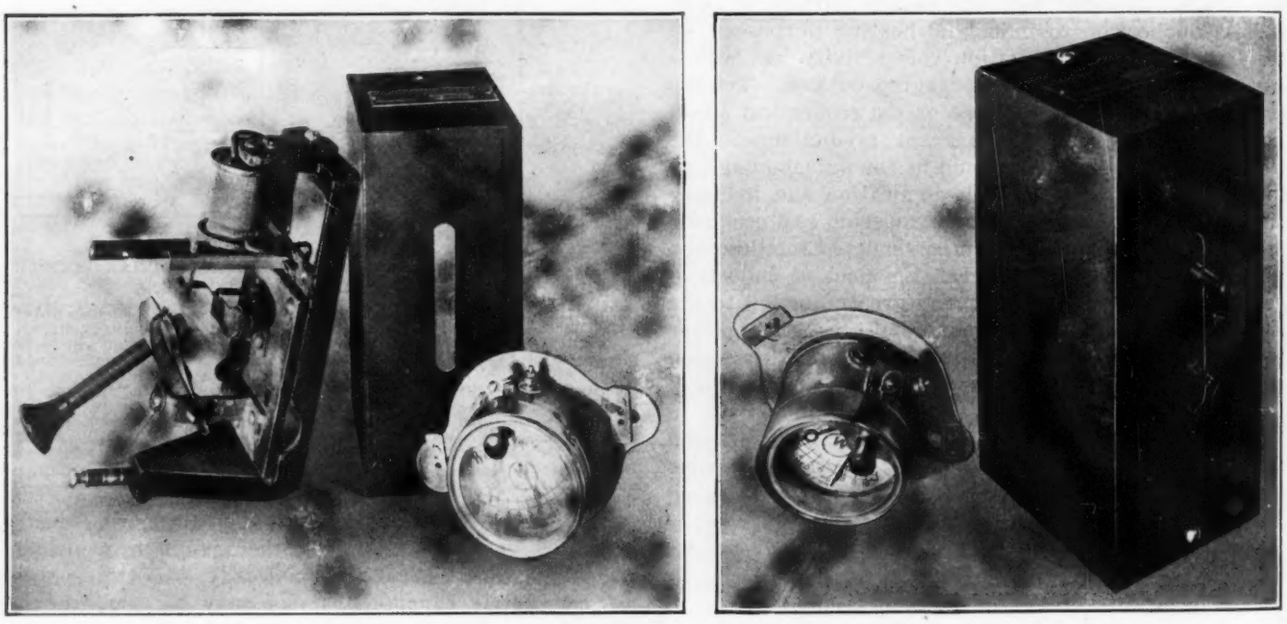
*This article is based on an address given by the author before the Toronto Sections of the A. I. E. E. and A. S. M. E.

TABLE I—ELECTRICAL RESISTOR MATERIALS

| Type | Content | General Remarks |
|---|---|---|
| Nichrome | 60 to 66 per cent nickel<br>12 to 22 per cent chromium<br>26 to 10 per cent iron<br>2 per cent manganese | Maximum working temperature of resistors about 1,800 deg. F. |
| Chrome or No. 1 chrome-nickel alloy | 80 per cent nickel<br>20 per cent chromium | Contains no iron or other impurity; highly acid-resisting and has high resistance to oxidation; maximum working temperature of resistors 2,000 deg. F. |
| Nickel-steel or ferro-nickel alloy | 25 per cent nickel<br>75 per cent iron | Maximum working temperature of resistors 1,100 deg. F. |
| Copper-nickel alloy | 45 to 65 per cent nickel<br>30 to 55 per cent copper | Maximum working temperature of resistors 900 deg. to 1,100 deg. F., and practically negligible temperature coefficient of resistance. |
| Carbon-granular or plate | Carbon | Maximum working temperature about 5,500 deg. F. |
| Carborundum | Amorphous carbon | Not a commercial success; decomposition occurs at about 4,000 deg. F., but hot spots develop so that furnace temperatures seldom exceed 2,500 deg. F. |

high-temperature furnaces, "Star" silica brick, "Quartzite" brick, first-quality "Woodland" brick, "Carbofrax" brick and other materials are used. Some of the insulating bricks weigh about 30 lb. per cubic foot, whereas the refractory brick weighs about four times this amount.

One of the problems of the industrial oven and furnace has been to determine the temperature with the degree of precision required. It is practically a universal practice to use the thermocouple up to 2,500 deg. F. The base-metal thermocouple usually is made of constantin and iron or nickel chromium and nickel alloy and is used up to 2,000 deg. F., although it deteriorates rapidly above 1,800 deg. F. The platinum or platinum-rhodium thermocouple is used up to 2,500 deg. or 3,000 deg. F., while the optical pyrometer is used above 2,500 deg. F. The base-metal resistance is not so constant, but the electromotive force is as constant as in the platinum theromocouple and several times greater. Readings are obtained by galvanometric or potentiometer methods.



A SAFETY THERMOSTAT CIRCUIT BREAKER FOR CONNECTION IN THE CONTROL CIRCUIT OF AN OVEN OR FURNACE—COVER ON OR COVER OFF

The resistor materials are arranged in some manner to form unit heating elements. Of these one of the most common is the grid-type heater made of nickel steel for immersion in oil, fats and greases. Still another is called the cartridge type, which consists of nichrome resistors wound on fireclay insulation and mounted in brass shells of various diameters to fit holes of different sizes. The wattage runs from 75 to 1,000 per heater and the maximum operating temperature is around 900 deg. F.; that is, 750 deg. F. at the work. These heaters are used in special machinery applications, largely in the rubber and shoe industries.

Still other types of heaters are the steel-clad and space heaters. These are so named because the heating elments are incased in steel and are designed to economize in space occupied. Mica insulation is employed for the space heater. The mica sheet is rolled into a tube on which the nichrome resistance ribbon is then wound. The tube is flattened, one terminal is placed at each end, and the flattened tube is then placed in a mica sheath, which in turn is placed in a heavy sheet-steel sheath. The flanges of this sheath are pressed down with a 10-ton pressure, and upon installation of the terminals the space heater is complete. The individual heating element is made in several sizes up to 1,250 watts, and the maximum operating temperature is about 1,000 deg. F. or 800 deg. F. at the work. In the steel-clad heater a punched ribbon resistor of nickel steel is employed. This is laid flat between sheaths of mica insulation. For this type the maximum operating temperature is about 600 deg. F., or 450 deg. F. at the work. These elements are made in several sizes up to 1,000 watts. The terminals are at one end so the heaters may more readily be inserted in the work.

The space heater is employed in a great variety of applications. It may be assembled in any desired numbers, depending upon the purpose for which it is to be used. One particular purpose is for use in air heating. Other applications of the space heater or steel-clad heater are in foot warmers, such as are used in traffic regulation, industrial hot tables and restaurant grills, heating of water tanks, mangle shoes and heating of pattern plates in molding machines.

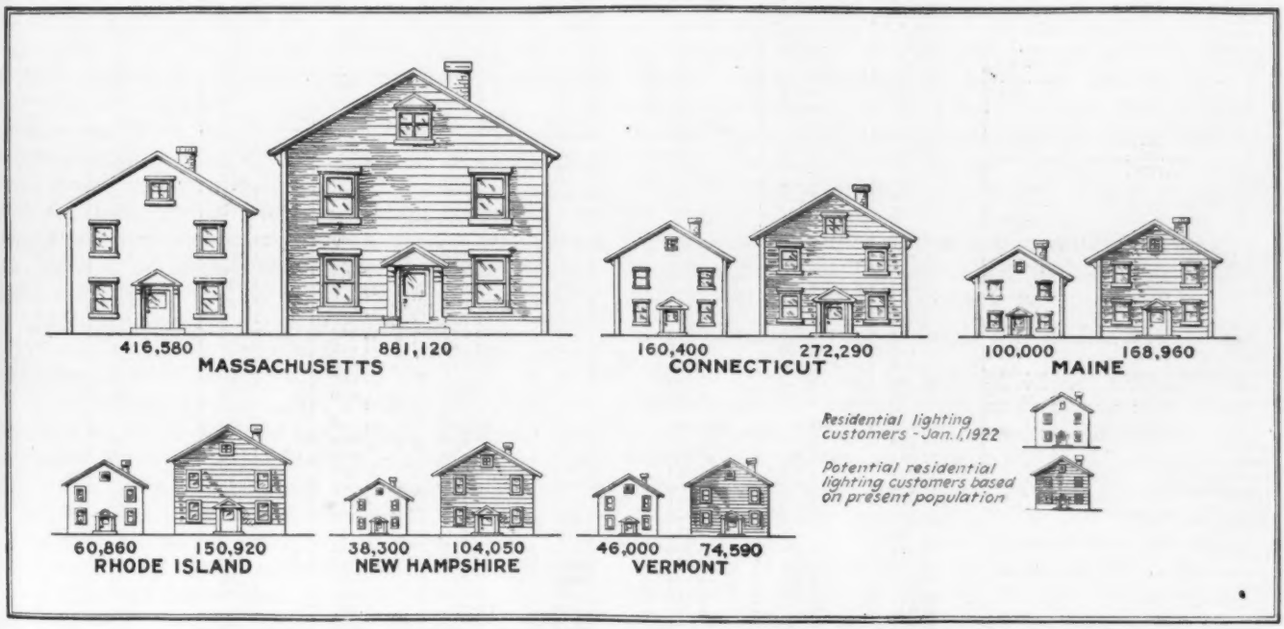
Still another type of heater is the industrial-oven heater. This consists of a nichrome resistance ribbon wound on fireclay insulators and mounted in a steel-rack frame of open construction. The element is made in various sizes from 1¾ kw. to 5 kw. for 110/220-volt service. The maximum operating temperature is around 900 deg. F., or 700 deg. F. at the work. Standard connectors and hooks for hanging in position are provided, and two 110-volt heating elements may be connected in series to operate on 220 volts, single-phase, or two 220-volt heating elements may be connected in series to operate on 440 volts, single-phase. Six 110-volt heating elements may be connected three-phase for operation either on 110-volt or on 220-volt, three-phase circuits. The installation and the connection of these heaters in the industrial ovens is a very simple matter indeed.

The control of the electric heating oven is a very important part of the operating process. As previ-

ously indicated, this is insured by means of the thermostat, or thermocouple and controlling pyrometer if the temperature is high. For a small industrial-oven installation a single-section control panel is employed. For example, for a capacity of 40 kw., or the equivalent of 120 amp., three-phase, 220 volts a single panel is used. For a larger oven or furnace installation individual section control panels are grouped into a board. For example, 2,200 kw. of heat at 550 volts employed in air heating in a large cotton mill of the Canadian Cotton Company near St. Stephen's, N. B., is controlled from two switchboards into which the individual sections are grouped. When grouping the control in this way the sectionalizing switches are usually segregated at one part of the board and the main automatic control contactors at another part. In some installations it is considered desirable to have a safety thermostatic circuit breaker connected in the regular control circuit in such a manner as to cause the opening of the main contactor in case the temperature accidentally becomes too high. This feature has been employed especially in armature insulation baking.

# Potential Customers in New England Total 2,069,000

"Electrical World's" Estimate of Present and Potential Customers of the New England States by Counties Indicates that a Total of About 48.3 per Cent of the Homes in This Section Are Electrified




IT IS POSSIBLE FOR THE NEW ENGLAND CENTRAL STATIONS AS A WHOLE TO DOUBLE THE PRESENT NUMBER OF DOMESTIC LIGHTING CUSTOMERS

ONE of the greatest problems involved in the distribution of electrical energy and of electrical apparatus and supplies is to obtain a reasonably accurate and detailed knowledge of the extent of the present market and of the potential possibilities of the market which is to be served. Given such a basis, it is a comparatively simple matter to apportion this market and to lay plans to take care of its future development.

With the idea of supplying this need, the ELECTRICAL WORLD has initiated a series of investigations which it is hoped will give the industry a reasonably accurate basis for ascertaining the extent of the present market for electrical energy and electrical apparatus and supplies in any desired locality and also for prognosticating the future market in that locality.

The first study undertaken is a segregation of the present central-station customers into the various counties of the states and an estimate of the potential number of the various classes of customers in each county under present conditions of population. Such figures are presented in the accompanying table for the various counties of the six New England States.

This study is based upon reports which have been received by the ELECTRICAL WORLD from operating companies representing about 70 per cent of the installed generator rating of the country supplemented by population and industrial power data issued by the United States Census Bureau. The data obtained in this way were referred to a representative company operating in the county concerned with the request that an opinion be given as to whether the data represent with a fair degree of accuracy conditions existent in that county. In the few cases where the company to which the figures were sent indicated that the ELECTRICAL WORLD figures were at variance with conditions in the

county a new study was made and the data were corrected accordingly.

The method used in determining the number of potential residential lighting customers, potential commercial lighting customers and potential industrial power customers was adopted after careful study. To arrive at the number of potential domestic lighting customers of any county it was assumed that all the families residing in the urban districts of that county fall within this category. It was also assumed that all the families residing in rural towns are potential domestic lighting customers, and that 50 per cent of the remaining families in rural districts are potential customers. Adding these three quantities gives the total potential domestic lighting customers of the county.

The number of potential commercial lighting customers was estimated by determining the present number of commercial lighting customers in the towns and cities reached by central-station lines and assuming that this number bears the same relation to the potential commercial lighting customers as the present number of domestic lighting customers in these towns and cities bears to the number of potential domestic lighting customers.

## Present and Potential Central-Station Customers in the New England States by Counties

| State and County | Population (Census of 1920) | | | Domestic Lighting Customers | | Commercial Lighting Customers | | Industrial Power Customers | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Urban* | Rural | Total (Jan. 1, 1922) | Total Potential (Including Present Customers) | Total (Jan. 1, 1922) | Total Potential (Including Present Customers) | Total (Jan. 1, 1922) | Total Potential (Including Present Customers) |
| **MAINE** | 768,014 | 551,055 | 216,959 | 100,000 | 168,960 | 24,600 | 37,190 | 4,790 | 16,260 |
| Androscoggin | 65,796 | 60,522 | 5,274 | 9,380 | 14,880 | 2,600 | 3,900 | 440 | 2,090 |
| Aroostook | 81,728 | 39,554 | 42,174 | 6,010 | 12,130 | 1,710 | 2,560 | 290 | 840 |
| Cumberland | 124,376 | 111,188 | 13,188 | 18,430 | 29,680 | 4,740 | 7,120 | 1,090 | 2,890 |
| Franklin | 19,825 | 12,306 | 7,519 | 3,000 | 4,820 | 750 | 1,120 | 190 | 550 |
| Hancock | 30,361 | 10,048 | 20,313 | 3,320 | 6,450 | 710 | 1,070 | 250 | 730 |
| Kennebec | 63,844 | 49,905 | 13,939 | 8,620 | 14,220 | 2,250 | 3,380 | 370 | 1,490 |
| Knox | 26,245 | 20,296 | 5,949 | 4,260 | 7,060 | 910 | 1,360 | 280 | 820 |
| Lincoln | 15,976 | 10,787 | 5,189 | 2,600 | 4,270 | 570 | 860 | 130 | 380 |
| Oxford | 37,700 | 21,339 | 16,361 | 4,650 | 8,020 | 1,170 | 1,750 | 270 | 790 |
| Penobscot | 87,684 | 65,679 | 22,005 | 11,080 | 18,730 | 2,270 | 3,400 | 400 | 1,440 |
| Piscataquis | 20,554 | 13,738 | 6,816 | 2,360 | 4,170 | 600 | 900 | 100 | 290 |
| Sagadahoc | 23,021 | 19,587 | 3,434 | 3,480 | 5,560 | 890 | 1,330 | 210 | 400 |
| Somerset | 37,171 | 23,692 | 13,479 | 5,080 | 8,520 | 1,260 | 1,890 | 220 | 640 |
| Waldo | 21,328 | 9,064 | 12,264 | 2,780 | 5,050 | 380 | 870 | 100 | 790 |
| Washington | 41,709 | 22,210 | 19,499 | 3,980 | 7,780 | 950 | 1,420 | 230 | 670 |
| York | 70,696 | 61,140 | 9,556 | 10,970 | 17,620 | 2,840 | 4,260 | 220 | 1,450 |
| **NEW HAMPSHIRE** | 443,083 | 376,860 | 66,223 | 38,300 | 104,050 | 9,500 | 24,290 | 2,370 | 8,540 |
| Belknap | 21,178 | 19,908 | 1,270 | 2,360 | 6,270 | 580 | 1,490 | 120 | 470 |
| Carroll | 15,017 | 7,700 | 7,317 | 1,080 | 3,260 | 260 | 670 | 70 | 210 |
| Cheshire | 30,975 | 28,100 | 2,875 | 3,200 | 7,710 | 780 | 1,990 | 210 | 210 |
| Coos | 36,093 | 30,600 | 5,493 | 2,560 | 7,090 | 640 | 1,630 | 240 | 610 |
| Grafton | 40,572 | 38,182 | 2,390 | 4,500 | 12,160 | 1,110 | 2,850 | 200 | 610 |
| Hillsborough | 135,512 | 126,600 | 8,912 | 11,240 | 30,260 | 2,804 | 7,170 | 810 | 2,980 |
| Merrimack | 51,770 | 46,600 | 5,170 | 4,630 | 12,480 | 1,180 | 3,010 | 310 | 910 |
| Rockingham | 52,498 | 26,900 | 25,598 | 3,520 | 10,720 | 860 | 2,190 | 230 | 930 |
| Strafford | 38,546 | 36,300 | 2,246 | 3,470 | 9,260 | 860 | 2,190 | 80 | 640 |
| Sullivan | 20,922 | 15,970 | 4,952 | 1,740 | 4,840 | 430 | 1,100 | 100 | 300 |
| **VERMONT** | 352,428 | 204,464 | 147,864 | 46,000 | 74,590 | 11,510 | 18,570 | 2,260 | 3,780 |
| Addison | 18,666 | 4,531 | 14,135 | 1,370 | 2,820 | 250 | 520 | 110 | 190 |
| Bennington | 21,577 | 11,456 | 10,121 | 2,600 | 4,430 | 630 | 1,070 | 150 | 260 |
| Caledonia | 25,762 | 14,701 | 11,061 | 3,940 | 6,095 | 960 | 1,490 | 160 | 280 |
| Chittenden | 43,708 | 28,956 | 14,752 | 5,100 | 8,515 | 1,340 | 2,240 | 310 | 660 |
| Essex | 7,364 | 2,653 | 4,711 | 790 | 1,390 | 190 | 330 | 20 | 30 |
| Franklin | 30,026 | 17,857 | 12,169 | 3,490 | 5,930 | 870 | 1,480 | 90 | 160 |
| Grand Isle | 3,784 | 0 | 3,784 | 90 | 455 | 10 | 50 | 10 | 20 |
| Lamoille | 11,858 | 7,398 | 4,460 | 1,660 | 2,625 | 420 | 660 | 80 | 140 |
| Orange | 17,279 | 6,506 | 10,773 | 2,280 | 3,855 | 510 | 860 | 100 | 170 |
| Orleans | 23,913 | 8,979 | 14,934 | 3,020 | 4,905 | 780 | 1,280 | 90 | 160 |
| Rutland | 46,213 | 31,796 | 14,417 | 6,270 | 9,955 | 1,620 | 2,580 | 290 | 460 |
| Washington | 38,921 | 30,178 | 8,743 | 6,320 | 9,275 | 1,680 | 2,460 | 520 | 680 |
| Windham | 26,373 | 14,385 | 11,888 | 3,670 | 5,865 | 840 | 1,340 | 170 | 290 |
| Windsor | 36,984 | 25,068 | 11,916 | 5,400 | 8,475 | 1,410 | 2,210 | 160 | 280 |
| **MASSACHUSETTS** | 3,852,356 | ..... | ..... | 416,580 | 881,120 | 96,710 | 176,800 | 20,930 | 44,930 |
| Barnstable | 26,670 | ..... | ..... | 3,840 | 7,750 | 600 | 1,210 | 50 | 90 |
| Berkshire | 113,033 | ..... | ..... | 13,020 | 26,300 | 2,020 | 4,080 | 310 | 1,010 |
| Bristol | 359,005 | ..... | ..... | 38,700 | 78,100 | 6,000 | 12,100 | 900 | 4,170 |
| Dukes | 4,372 | ..... | ..... | 630 | 1,270 | 100 | 200 | 20 | 40 |
| Essex | 482,156 | ..... | ..... | 55,300 | 111,600 | 8,560 | 17,300 | 1,850 | 7,170 |
| Franklin | 49,361 | ..... | ..... | 5,950 | 12,020 | 920 | 1,860 | 320 | 490 |
| Hampden | 300,305 | ..... | ..... | 41,840 | 75,000 | 10,460 | 15,000 | 3,490 | 5,000 |
| Hampshire | 69,599 | ..... | ..... | 7,670 | 15,500 | 1,190 | 2,400 | 420 | 640 |
| Middlesex | 778,352 | ..... | ..... | 89,000 | 179,500 | 14,310 | 28,850 | 2,320 | 4,800 |
| Nantucket | 2,797 | ..... | ..... | 430 | 880 | 70 | 140 | 10 | 20 |
| Norfolk | 219,081 | ..... | ..... | 33,000 | 50,000 | 7,300 | 14,600 | 910 | 1,560 |
| Plymouth | 156,968 | ..... | ..... | 19,200 | 38,700 | 2,960 | 5,960 | 630 | 1,570 |
| Suffolk | 835,522 | ..... | ..... | 58,000 | 183,700 | 34,500 | 57,500 | 7,260 | 13,200 |
| Worcester | 455,135 | ..... | ..... | 50,000 | 100,800 | 7,720 | 15,600 | 2,440 | 5,170 |
| **RHODE ISLAND** | 604,397 | ..... | ..... | 60,860 | 137,970 | 10,690 | 23,990 | 3,800 | 10,020 |
| Bristol | 23,113 | ..... | ..... | 2,150 | 5,110 | 370 | 900 | 90 | 240 |
| Kent | 38,269 | ..... | ..... | 6,790 | 9,660 | 1,360 | 1,830 | 260 | 360 |
| Newport | 42,893 | ..... | ..... | 3,990 | 9,480 | 690 | 1,640 | 140 | 390 |
| Providence | 475,190 | ..... | ..... | 45,200 | 107,250 | 7,800 | 18,500 | 3,240 | 8,780 |
| Washington | 24,932 | ..... | ..... | 2,730 | 6,470 | 470 | 1,120 | 70 | 250 |
| **CONNECTICUT** | 1,380,631 | 1,016,227 | 364,404 | 160,400 | 272,790 | 27,570 | 47,520 | 9,330 | 19,390 |
| Fairfield | 320,936 | 243,158 | 77,778 | 36,280 | 65,200 | 6,410 | 11,500 | 2,030 | 4,680 |
| Hartford | 336,027 | 241,360 | 94,667 | 44,920 | 63,770 | 7,370 | 11,030 | 3,130 | 3,860 |
| Litchfield | 76,262 | 38,911 | 37,351 | 6,910 | 14,010 | 1,130 | 2,290 | 300 | 1,060 |
| Middlesex | 47,550 | 26,059 | 21,491 | 4,340 | 8,560 | 720 | 1,420 | 470 | 870 |
| New Haven | 415,214 | 350,571 | 64,643 | 48,790 | 84,850 | 8,760 | 15,240 | 2,390 | 6,810 |
| New London | 104,611 | 64,533 | 40,078 | 10,440 | 20,140 | 1,670 | 3,220 | 600 | 1,190 |
| Tolland | 27,216 | 19,300 | 7,916 | 3,290 | 5,910 | 580 | 1,040 | 170 | 300 |
| Windham | 52,815 | 32,335 | 20,480 | 5,430 | 10,350 | 930 | 1,780 | 240 | 620 |

* Cities and towns over 1,000 population.

# Central Stations and Technical Schools*

## Need of Closer Relations Between Operating Companies and Educational Institutions — Mutual Benefits of Co-operative Courses— What Is Being Done by the Brooklyn Edison Company

By M. S. SLOAN
*President Brooklyn Edison Company*

TECHNICAL training has progressed in the past thirty or forty years to the point where the graduate of a two-year industrial training course probably knows more about electricity than Edison did when he built the Pearl Street station in New York City. What will the future require of men entering the industry in comparison with our present needs?

We must sharply differentiate between the two types of educational institutions and the two types of training for which we have use in our industry. First and more extensive, there is the trade or vocational training, which fits men for various manual or semi-manual employments, which produces the rank and file and the non-commissioned officers of the industry; second, there is the professional or university training which provides staff and line officers.

There are in the country today a few good vocational schools—all too few, be it said. To these we should give every possible encouragement and guidance, and to them our industry can offer very much in the way of direct, specific, tangible help. These schools take young men fresh from high school, or without even a high-school diploma, give them familiarity with the specific arts and methods of the various industries, train them in process, acquaint them with fact and incidentally teach them how to think.

To such schools we can supply much detailed information concerning the needs of our industry. For them we can supply opportunity for inspection trips and to some degree field tests. With them it is possible for us to develop co-operative relations wherein the students may be employed on part time on our properties. To them we can send some of our more promising men for night or part-time day instruction, ourselves deriving a direct benefit through specific individuals among the student body.

### FUNDAMENTALS BASIS IN PROFESSIONAL TRAINING

In the other class stand the great professional schools and universities which, on more or less rigid entrance requirements, admit students from preparatory schools, which give those students training intended not primarily to make them of direct value to my company or to yours, to this particular industry or to that; but which do plan with a certain amount of training in the specific arts to produce first a trained mind, the power to observe, intellectual vigor and a sense of discrimination.

Our service to such schools and the service which we may expect to receive from them must of necessity be indirect, somewhat intangible and general in character. As these schools do not pretend to communicate to their students the specific and immediate facts of today concerning the industry, what we can contribute to them in the way of information must of necessity be of value only as the faculties themselves can use this information as source material on which to base their educational process. Remote and intangible though such co-operative effort must of necessity be, it is at the same time well worth the making.

I am profoundly convinced that much of the difficulty which we have had with the so-called socialistic college professor is not a result of any fundamental incapacity to think or of perversity of either spirit or mind, but is rather the direct consequence of the fact that he does not know either the facts of our industry or us as individuals. Anything we can do, then, to bring ourselves in touch with professors of economics and business administration, of law and political science, in our institutions of higher learning will, unless our industry is on a lower plane than I conceive it to be, have the effect of giving these men the opportunity which they as searching apostles of truth should, and I believe do, welcome to get the basic facts from which their conclusions must be drawn.

The academic mind runs pretty straight once started in the right direction, but given an initial prejudice, runs equally straight under that impetus.

### RESEARCH FELLOWSHIPS POINT THE WAY

I can conceive of no greater co-operative service, valuable alike to our universities as institutions where above all else the truth is esteemed and to us, who desire above all else that the truth about us shall be believed, than that we should, through the establishment of research fellowships, offer our industry as source material for graduate students and professors competent to make a study of public utility problems. More will be heard of this in the not distant future through the N. E. L. A. committee on co-operation with educational institutions, in whose work my own company is taking a very active interest.

Both in industry and in academic circles there is a persistent query as to what the schools can do for industry, meaning thereby what direct, tangible things the schools can do to stimulate our industrial activities and to increase our prosperity. Without disparagement of the value of research and of the solution of our specific problems, I suggest that the greatest service which any school can possibly render to the nation and to industry is to be an *educational* institution. The chief reason for the existence of our universities is to prepare young men for life and for the service of society. So long as specific undertakings contribute to that purpose, these specific undertakings are to be encouraged; but above all else, if our civilization is to be progressive, the schools must produce men who can advance human knowledge and the application of it to the well-being of humanity.

Many young men fresh from college have a tremen-

*From a paper presented before the New England Division of the N. E. L. A. at a public policy session in Boston, March 8, 1923.

dous store of "facts" which would be so if they were true! They know how to design anything from a major power plant up, but do not have their feet securely on the ground when it come to rigorous thinking from facts carefully observed. We must encourage our colleges to teach little, to teach that little well, and to develop in the students the habit of work.

In earlier days young men gained their acquaintance with our industries through apprenticeships at nominal wage, at no wage at all, or sometimes even paying for the privilege. That day is past. The young man fresh from college can today earn a living wage which will enable him to keep body and soul together until he has developed some practical value. I believe it to be our responsibility to create more full opportunity for the modern equivalent of the old type of apprenticeship —something after the fashion earlier established by the Santa Fé Railroad and by the great manufacturing companies in the electrical industry. My own company now has in formation a cadet course for college graduates. We may take on more young men than we can ultimately absorb. Future opportunity for them must be created either by graduating out of the company bureau heads who can go to larger responsibility with other concerns or through losing some of our cadets after a year or two of experience with us. What we have invested in the entire group will doubtless be repaid through an opportunity to select from the group whatever percentage we are able ultimately to retain.

### Co-operation with the Brooklyn Polytechnic

With the other type of institution and with its possibilities of service to us we have had nearly a year of actual experience. We formerly had in our company an educational department internally manned. For various reasons the results were not altogether satisfactory. We have in Brooklyn one of the best of semi-vocational schools—the Brooklyn Polytechnic Institute. Like few other institutions of its class, it approaches closely to the university standard. This institute is headed by Dr. F. W. Atkinson, a man of the highest attainments, of broad perspective, a splendid administrator, and with an admirable faculty under him. Being peculiarly a Brooklyn organization and convenient to our work it occurred to me as a trustee of the institute that the Brooklyn Edison Company might profitably use it in improving the utility's training courses.

We created in the department of economics and statistics a Bureau of Education, under the immediate supervision of Prof. Robin Beach of the institute's electrical engineering department. In the educational work given to company employees we have been able to utilize members of the institute faculty and company employees. The former have been placed on the company payroll at modest but at the same time adequate salaries. Some twenty-five of our own employees, department and bureau heads for the most part, are used as special instructors and lecturers. To these latter we pay an "honorarium" of $5 per evening. Courses are offered under two general classifications, technical and commercial. The former cover such subjects as the elements of electricity, direct-current and alternating-current machinery, meter practice, principles of combustion, switchboard operation and industrial applications. The latter include such topics as sales of electrical appliances, theory and practice of filing, personnel and office efficiency, accounting, general organization, sales department organization and English.

Although most of these courses are offered in the evening, some are given at daytime hours convenient to men working on the night shift. Usually the sessions last one hour, but two hours are allotted to laboratory sessions. Four courses last about eight weeks, but most of them run twenty-five weeks.

### One-fifth of the Brooklyn Edison Company Employees Enrolled

Against 209 enrolled students in company courses last year, we now have 934 enrolled in the co-operative courses. The course elections last year were 217; now they are 1,364. Twenty-one and one-half per cent of our employees are registered in courses, the secretary's department having a 71 per cent enrollment, one engineering department 57 per cent and the sales department 44 per cent. Attendance and interest have been most satisfactory.

As this work is vocational training and not a process of general education, we are attempting to relate the subject matter of the courses as closely as may be to the specific problems occurring in the company's work. I do not believe that good results flow from doing so much for an employee as to make him feel that he is the subject of a kindly paternalism. We have, therefore, required those enrolling to pay a fee at the time of electing the course, but in recognition of the earnestness and application of those who complete the courses satisfactorily the fee is refunded at the conclusion of the instruction.

While it is too early to discuss definite results, I and all my department heads are sensible of certain benefits which were predicted by Professor Beach. These are mutual to the institute and to the company. The advantages to the company reside in the fact that under a centralized system of company industrial education employees are efficiently, economically, expeditiously and consistently trained to perform their duties. Their perspective becomes broadened so that they grasp better the relation of their work to the general activities of the company. Whatever increases the earning capacity of employees increases their value to the company. This educational opportunity serves to draw together employees of different departments in a common undertaking, thereby promoting mutual appreciation.

Our practical men, on the other hand, communicate through their lectures something which the schoolmen can use with a great deal of advantage in their regular work in the institute. We have gladly placed at the disposal of the institute much of our machinery and equipment and have encouraged inspections of our properties by faculty and students. The faculty derives opportunity to keep in touch with our most recent advances, to gage the needs of at least one industry and to find an outlet for institute graduates. We are incidentally creating some opportunity for the institute instructors to collaborate with our engineers and investigators on certain special problems.

I do not mean to say that we have worked this problem through to anything like its final conclusion, but the results are so good that we cannot consider as anything other than profitable the increase of our 1921-1922 educational budget from $12,000 to $17,000 for 1922-1923, and I am not in the least degree hesitant in suggesting that no company which has closely at hand such an institution as the Brooklyn Polytechnic Institute can afford not to utilize its faculties and its laboratories in carrying on a company educational program.

# Experience with the Radiophone

## First Report of Any Length Relating the San Joaquin Light & Power Corporation's Experience with Radio—Conditions that Led to the Adoption of Equipment—50-Watt Tubes Used—Consistent Reception Reported from Distance

By R. C. DENNY

*Operating Engineer San Joaquin Light & Power Corporation, Fresno, Calif.*

COGNIZANT of the need of an emergency means of communication to carry on system dispatching during periods when the telephone lines were from any case disabled, the San Joaquin Light & Power Corporation of Fresno, Cal., in the fall of 1921 undertook the development of a practical radiophone. The chief requirement in such an instrument was that of consistent operation day or night over a maximum radius of 135 miles from the dispatcher's office at Fresno in a southwesterly direction. The distance requirements in other directions were approximately half as great, but, owing to the fact that these shorter distances were over a mountainous country into deep canyons, the requirements were quite severe, nevertheless.

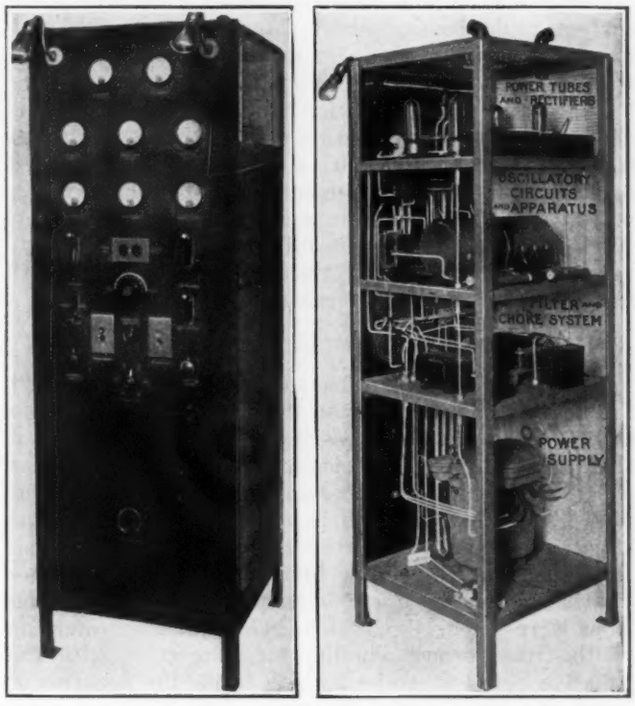
The fact that transmission was desired in all directions out from the operating center of the system rather eliminated the "wired wireless" or carrier-current system, with its limitations, from consideration. Moreover, the failure of communication is in the majority of cases incidental or secondary to failures of the transmission lines, which, in case either telephone lines or transmission lines were used for the purpose, would render the carrier system useless just at the time it was most needed.

### System Used Must Be Reliable in Emergencies

Obviously, then, to be practicable under the most adverse conditions emergency communication must be entirely separate and independent of the lines. Manifestly, it is only adverse conditions constituting emergencies that really justify any system of radio, as fully 95 per cent of the time the line telephone system functions properly and is entirely adequate. Therefore, in view of the notorious inefficiency of radio transmission, it would seem extremely uneconomical to use any form of radio where the telephone would suffice, except, of course, for emergencies.

Particularly is this true in cases in which radio is applied to systems where telephone lines already exist and where they are strung beneath the transmission lines. It is admittedly a fact that on new projects where long transmission lines are to be built the carrier-current telephone system may be used for routine work over the transmission conductors in lieu of building separate telephone lines. A saving can be thus effected provided that the initial cost of the carrier-current apparatus is kept down within reason. However, unless the transmission lines are provided in duplicate it is rather doubtful whether the carrier system would suffice in the case of line failures where one or several spans have come down or are tangled up and grounded.

Thus it is very dubious whether the carrier-current system will be of any great value in emergencies. At any rate, it becomes rather apparent that each of the two systems of communication has its own field—the radiophone where an extensive interconnected transmission network of one, two or three voltages is to be talked over in any or all directions, and the carrier-current scheme for talking over especiallly long and important transmission lines where communication is desired only at the terminals. In fact, several companies are adapting the carrier-current system to certain more important stretches of their transmission system because of the government radio regulations, which are rather inclined to handicap the use of the radiophone even for emergency operation. Whether carrier current will prove entirely successful in emergencies is yet to be demonstrated.




FRONT AND REAR VIEWS OF 50-WATT RADIOPHONE SET

The power tubes and rectifiers are mounted on the top shelf, the oscillatory circuits and apparatus on the next shelf, the filter and choke system below, and the power supply equipment on the bottom shelf.

Another requirement to be met in the development of a practical radiophone for emergency use was that it should not cost one whit more than was commensurable with successful and consistent operation. Still another was that it should be simple in operation and adjustments and involve low maintenance expense. With these and the distance requirements in mind the writer set about the development of such a radio-telephone set. At that time, and with only the experiences of two other radio-telephone installations to be judged from, it was

decided that a set of 50 watts output rating, if that output were properly modulated, would meet the distance requirements. Advice from several of the large manufacturers that at least 250 watts would be required, and that 1,000 watts was recommended, did not affect the original decision.

From the outset it was decided to eliminate the one item of greatest expense formerly used in such sets, that being the motor-generator set for the production of high-voltage direct current. Experiments with an electrolytic rectifier proved conclusively that alternating current could be used if the resultant pulsating direct current could be sufficiently filtered or smoothed out to minimize if not eliminate the fundamental hum. It was soon demonstrated, though, that, because of overheating, the chemical device for rectification was inadequate for constant use on currents even as low as 300 milliamperes at 1,000 volts. Besides being very inefficient, it was cumbersome and "mussy," which militated against its use in a compact and finished set. Having served the very useful purpose of demonstrating the possibilities of rectified alternating current, it was discarded in favor of vacuum-tube rectifiers.

### Heat Filaments with Alternating Current

It was also very desirable to use alternating current for heating the filaments of the various vacuum tubes to be used in the set. Besides being more economical than using storage batteries and much more simple as well than low-voltage generators, and more easily regulated, it actually results in a longer filament life as emission is more even from all parts of the filament. In actual service it was found very feasible to use alternating current for this purpose if certain precautions were taken. One was to bring out the center tap of the transformer winding for connection with the negative high-voltage lead which forms the negative or common connection for the entire set. Telephone condensers rated at 1 mf. should be bridged across from this center tap to each end of the winding, these to serve as a low-impedance path or bypass for the high-frequency currents from the oscillator tube. Ordinary potential transformers were rebuilt or remodeled for the purposes of filament heating and high voltage for the rectifier, and these, too, proved to be inadequate owing to overheating when used continuously. However, they served their purpose, permitting the experiments to be carried on while properly designed apparatus of adequate capacity was being developed.

One thing that became apparent in the early stages of the experiments was the necessity for low antenna resistance. An aërial and ground system that had been perfectly satisfactory for the spark system of radio telegraphy, employing spark frequencies on the order of 1,000 per second, would not serve at all for the high frequency of the radiophone carrier wave, which was something over 833,000 cycles at the particular wave length at which the experiments were carried on. Accordingly a counter-capacity antenna or counterpoise was designed having the same physical dimensions as the antenna and erected directly beneath it and parallel to it at a distance of 40 ft., this being influenced by local conditions. Every precaution was taken to keep the ohmic resistance as low as possible, stranded copper conductors being used, heavy leads employed and all joints soldered. A marked increase in radiation was the result, practically three and one-half times the former current. It was found possible to increase the radiation further by connecting the ground lead to a certain point on the inductance coil, so that with the combination of counterpoise and ground connection radiation was four times that obtained with ground alone.

In order to bring in reports from all directions on the operations during the experimental development of the radiophone it was necessary to do a certain amount of broadcasting. Another and fully as important reason for broadcasting was to stimulate an interest in radio among the power-house and substation employees about the system. It was considered that such interest was vitally important to the successful future operation of an emergency radiophone service. This was done under an experimental license until a ruling of the Department of Commerce necessitated taking out a special broadcasting license for the purpose. It was thus that the company's broadcasting station KMJ came into existence, but with the idea of a broadcasting station secondary to the development of the set for use in emergency communication.

After many months of delay occasioned by the inability to get satisfactory tubes and apparatus, hardly any of which were more than out of the experimental stage and on a production basis, a complete set of standard parts was evolved. A satisfactory filter system had in this time been developed, utilizing the primary winding of a 1-kw., 2,300-volt distribution transformer as a choke, the two coils each in series with one side of the rectified high-voltage supply. Three 1-mf. condensers insulated for 1,750 volts were shunted across this circuit on the power side and one on the radio side.

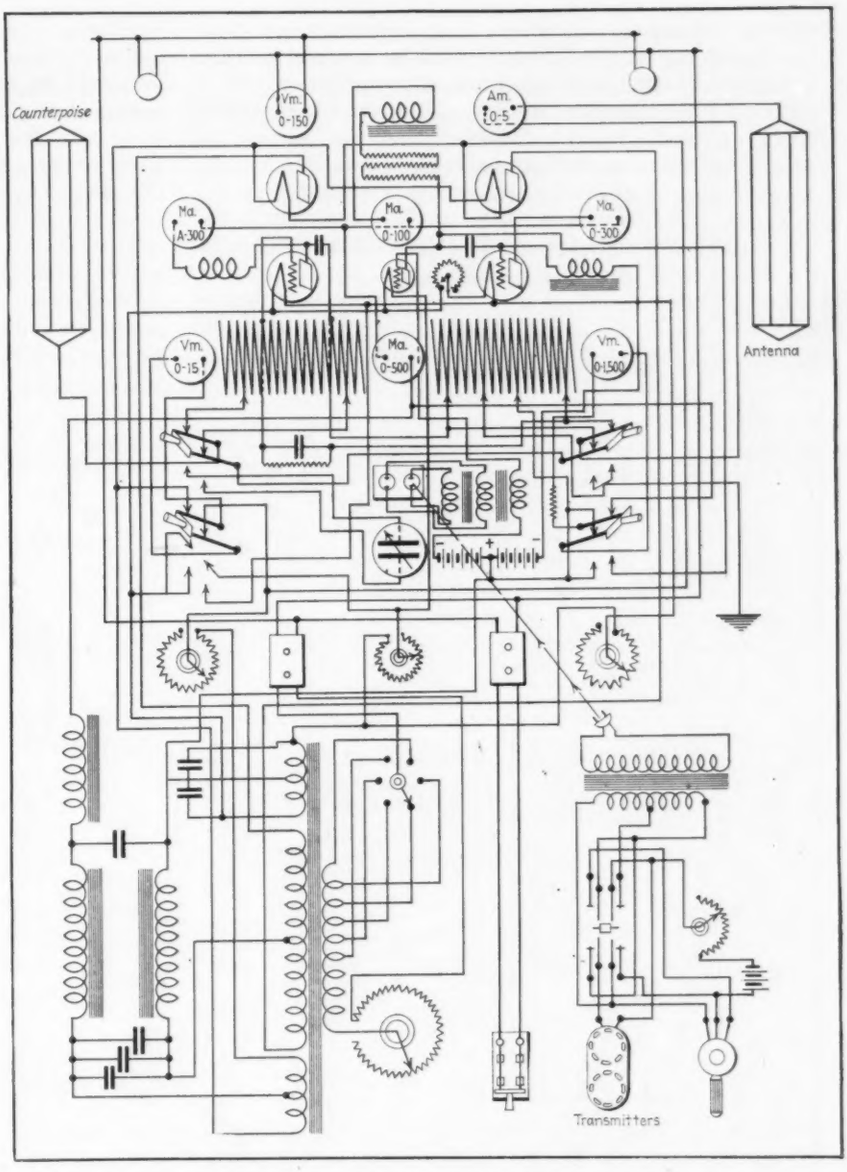
A special but standard transformer of 750 watts rating was used for the one source of power. This transformer has one primary winding, with taps for operation on from 102.5 volts to 115 volts, and three secondary windings, two of which give 10.5 volts for filament heating and one 3,000 volts for the rectifier tubes. Each of these secondary windings has its center tap brought out, a connection which is absolutely essential. It was found in actual practice that this transformer, which is of the dry type, when operating continuously at just full load for an hour at a time became dangerously hot. For this reason it was necessary to rearrange the terminal connections, soldering on long leads and sawing out sections of the end shells preparing the transformer for operation under oil. It was put into a 1-kw. distribution transformer case, submerged in oil, and the operation since has been entirely satisfactory. Owing to the primary voltage sometimes going above the transformer voltage rating, a 40-ohm rheostat is provided in the primary circuit.

Power for the set is supplied from the 115-volt lighting circuit of 60 cycles frequency. Entering the set through a fused knife switch it passes through a flush-type lock switch to the main power bus and thence to the bracket lamps and alternating-current voltmeter. This meter indicates which voltage tap to work on, so the tap selector switch is moved to the proper point and with the primary resistance all in the flush push switch is snapped on. The primary resistance is then cut out gradually and the set brought up to normal operation.

Power tubes of 50 watts output rating are used, one as an oscillator and the other as the modulator. The constant-current system of modulation is used in connection with a 5-watt speech amplifier. A special reactor

of 300 milliamperes capacity is used in the main positive lead to the plates. The power tubes require at least 1,000 volts on the plates, while the speech amplifier tube requires 350. A resistance of 15,000 ohms having a continuous carrying capacity of at least 50 milliamperes was found necessary to reduce the voltage to the proper value. This resistance was composed of three standard 5,000-ohm resistors. A direct-current voltmeter is provided which by means of a double-pole, double-throw switch may be thrown on the power-tube plate circuit or upon that of the amplifier tube. The rectifier tubes have an output rating of 150 watts each, and the two carry a load of 300 milliamperes at 1,300 volts without undue heating. Two standard rheostats of 15-amp. continuous carrying capacity are provided, one for each set of tubes that operate in multiple. An additional rheostat is provided for the modulator tube, which sometimes requires a slightly different adjustment from the oscillator. A separate rheostat is provided for the speech-amplifier tube, which requires a considerably lower voltage for its filament.

The constant-potential method of filament control is used rather than maintaining the constant rated current throughout the life of the tube. It is found that this method greatly prolongs the life of a tube, since the current is automatically reduced as the filament resistance increases because of disintegration. An alternating-current voltmeter is provided for this purpose which by means of a double-pole, three-way switch may be thrown upon either the rectifier tube bus or the power-tube bus or onto the speech-amplifier tube and the voltage adjusted by means of the respective rheostats. The plate current of the oscillator and modulator tubes and the speech-amplifier tubes are indicated separately by milliammeters and collectively by one meter which gives the total load on the rectifier tubes.




WIRING DIAGRAM OF 50-WATT ALTERNATING-CURRENT-OPERATED RADIOPHONE TRANSMITTING SET OF SAN JOAQUIN LIGHT & POWER CORPORATION

### OSCILLATORY CIRCUIT ARRANGED FOR LONG AND SHORT WAVE WORK

In the oscillatory circuit are utilized two standard inductance coils of twenty-five turns each, two fixed-capacity 3,000-volt mica condensers of 0.002 mf. each, one variable mercury-mica condenser of 0.0012 mf. insulated for 4,000 volts, and one 5,000-ohm resistor which is used as a grid leak on the oscillator tube. One of the inductance coils is to be used as a loading coil for long-wave work, while the variable condenser is for short-wave work, either of which may be introduced into the counterpoise lead by the proper operation of a double-pole, double-throw switch. Another double-pole, double-throw switch is provided, which is used either to connect the antenna and counterpoise to the active inductance or to ground them both. Small choke coils of 1 henry reactance at audio frequencies are inserted in the grid circuit of the modulator tube and the plate circuit of the speech amplifier to prevent the dissipation of the audio-frequency impulses and practically forcing the effect of the speech amplifier upon the grid of the modulator tube. A radio-frequency choke coil is inserted in the plate lead of the oscillator tube to prevent the high-frequency output of that tube getting back into the other circuits. The output or plate circuit of the speech-amplifier tubes is capacitatively coupled to the grid of the modulator by means of a ½-mf., 1,750-volt condenser. Negative potential for the grids of the two tubes is supplied by small dry batteries, the values approximating 30 volts.

A three-winding modulation transformer is used, the secondary of which connects with the grid of the speech-amplifier tube. The primary winding connects with a receptacle on the panel for external connection to the speech-input circuit. The tertiary or third winding also connects to a receptacle so that the input may be monitored by plugging a telephone receiver in on it. The microphone system, which is external to the trans-

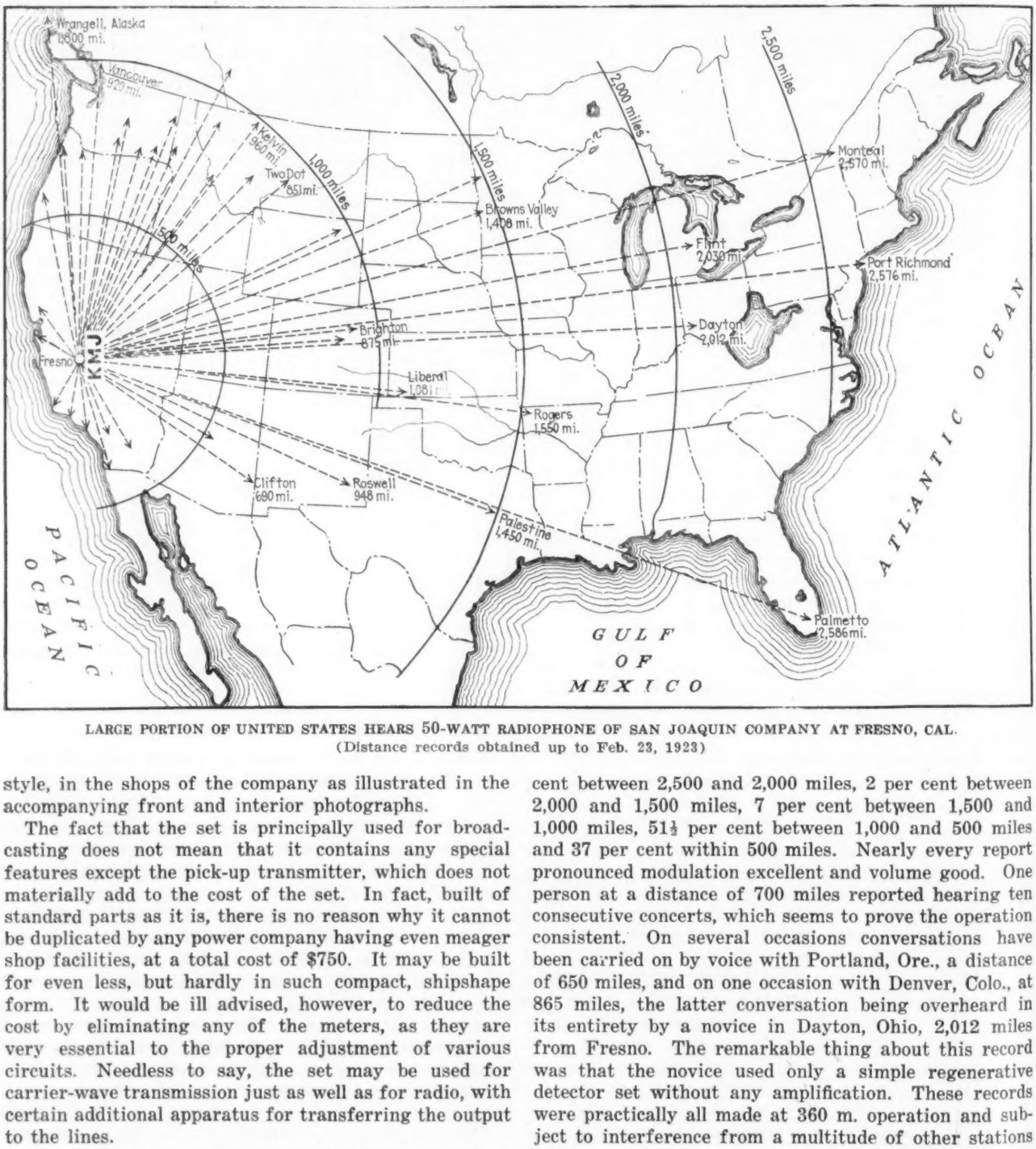
mitting set proper, consists of an induction coil with the center tap of the primary winding brought out for connection with the differential transmitter, which is a hand set used for announcing. The other transmitter is an especially sensitive device used for picking up vocal and instrumental music rendered in the studio. A four-point, double-throw telephone key switch serves to throw from one transmitter to the other, while the one battery and rheostat are used for both transmitters, the rheostat to control the volume.

The detailed description of the set may be followed with the aid of the wiring diagram reproduced. The set was designed by the writer and built up, switchboard style, in the shops of the company as illustrated in the accompanying front and interior photographs.

The fact that the set is principally used for broadcasting does not mean that it contains any special features except the pick-up transmitter, which does not materially add to the cost of the set. In fact, built of standard parts as it is, there is no reason why it cannot be duplicated by any power company having even meager shop facilities, at a total cost of $750. It may be built for even less, but hardly in such compact, shipshape form. It would be ill advised, however, to reduce the cost by eliminating any of the meters, as they are very essential to the proper adjustment of various circuits. Needless to say, the set may be used for carrier-wave transmission just as well as for radio, with certain additional apparatus for transferring the output to the lines.

Operating at normal power input rating, on a four-wire, flat-top T-type antenna 75 ft. high and 175 ft. long and a counterpoise of similar dimensions, this set has a normal radiation of 4 amp. at 360 m., which is indicated by a radio-frequency ammeter of the thermo-couple type. Modulation, effected by speaking or whistling into the transmitter, produces from 0.2 amp. to 1 amp. variation in the radiation. This is known as the percentage modulation, and it is upon this that the voice range of the set depends to a large extent. It is possible to get a higher percentage modulation, but hardly without distortion.

Of the total number of reports on overland reception of speech and music from this set, 2 per cent were from stations more than 2,500 miles from Fresno, 1½ per cent between 2,500 and 2,000 miles, 2 per cent between 2,000 and 1,500 miles, 7 per cent between 1,500 and 1,000 miles, 51½ per cent between 1,000 and 500 miles and 37 per cent within 500 miles. Nearly every report pronounced modulation excellent and volume good. One person at a distance of 700 miles reported hearing ten consecutive concerts, which seems to prove the operation consistent. On several occasions conversations have been carried on by voice with Portland, Ore., a distance of 650 miles, and on one occasion with Denver, Colo., at 865 miles, the latter conversation being overheard in its entirety by a novice in Dayton, Ohio, 2,012 miles from Fresno. The remarkable thing about this record was that the novice used only a simple regenerative detector set without any amplification. These records were practically all made at 360 m. operation and subject to interference from a multitude of other stations broadcasting at the same or very nearly the same wave length.




LARGE PORTION OF UNITED STATES HEARS 50-WATT RADIOPHONE OF SAN JOAQUIN COMPANY AT FRESNO, CAL.
(Distance records obtained up to Feb. 23, 1923)

Therefore it is obvious that operating at much higher wave lengths, which would be the case in emergency operation as limited commercial stations, there would be virtually no interference and very consistent results would be had.

These records might seem to indicate that much more power than necessary was being used to cover the power system in question. Possibly so, but the power tube of the next smaller size has an output rating of only 5 watts, which is ostensibly not enough. Operating tubes in multiple to increase the output rating of a set is not particularly satisfactory without a complication of controls and meters, which immediately runs into expense. For such reasons it was considered inadvisable to experiment with less than a 50-watt tube; it was felt also that for operation through the summer months such capacity was not in any great excess for the service demand of the equipment.

### CONTINUITY OF RECEPTION LARGELY A MATTER OF TRAINING

Although it was not the intention that problems of reception should be within the scope of this article, the writer desires to remark that in his opinion the success of duplex operation of the radio telephone is going to hinge pretty much on the receiving end; but, after all, this is largely a matter of training the operating personnel. Broadcasting is having just that effect—not merely the San Joaquin corporation's efforts, but broadcasting in general is serving to acquaint the power man with receiving sets, getting him accustomed to the more or less delicate adjustments of the instruments. Numerous tests made about the San Joaquin system have well demonstrated the success of ordinary receiving sets employing one or two stages of audio-frequency amplification, connected with outdoor antennas. However, before duplex operation of the radiophone can be a complete success it will be necessary to resort to loop reception and radio-frequency amplification. This will permit stations transmitting at one wave length and, while transmitting, receiving at another wave length without interference from their own transmitter. This is the next problem to be attacked, now that much has been learned about radio-frequency amplification. A complete receiving set including a loud-speaking device should not cost more than $250, making a total investment of perhaps $1,000 for a complete two-way radio station.

## Making Water Work Upward

ARTESIAN wells are quite prevalent in the northern and middle parts of Florida, the necessary pressure evidently coming from some northern elevation, perhaps the Appalachians. It occurred to a local inventor with some vision that a water pressure upward is, as a source of power, just as good as the usual pressure downward. So he developed some small reaction turbines which could be mounted directly over an artesian well. They are made in sizes from 150 watts to 2,000 watts, directly connected to 32-volt or 110-volt direct-current generators. A storage battery is used with each outfit, and the main purpose of the generator is that of charging the battery continuously at a low rate.

The conditions are such that no centrifugal governor or electric regulator is necessary, and the outfit is exceedingly simple. Since an overflow is desirable, anyway, to keep an artesian well in a good condition, the farmer gets his light and power and still has his irrigation water. This method for producing power locally can be applied to advantage in several localities along the Gulf Coast where these artesian wells are found.

## Chemicals Produced by the Aid of Electricity

THE Department of Commerce announces that the reports made to the Bureau of the Census show a production of chemicals by processes involving the use of electricity of the value of $58,180,500 in 1921, as compared with $82,590,000 in 1919, a decrease of almost 30 per cent. In 1914 the value of chemicals produced by the aid of electricity was only $29,661,949. The increase, therefore, for the seven-year period, 1921-1914, was 96 per cent. The establishments reporting were 127 in number in 1921, 114 in 1919 and 36 in 1914. The principal products so produced, named in the order of value, are aluminum, the ferro-alloys, calcium carbide, chlorine bleaches (including chlorine and the hypochlorites), sodium hydroxide, the abrasives (including aluminous and siliceous), peroxide of hydrogen and oxygen. Many of these products serve as basic raw material for the production of a great variety of other chemicals.

Detailed statistics for 1921 and 1919 are given in the accompanying table. The statistics for 1921 are preliminary, and subject to such change and correction as may be necessary from a further examination of the original reports.

CHEMICALS PRODUCED WITH THE AID OF ELECTRICITY

| | 1921 | | 1919 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Chlorine Bleaches: | | | | |
| Chlorine (for sale), lb. | 36,211,000 | $1,955,900 | 34,392,000 | $1,425,917 |
| Hypochlorites, lb. | 168,774,000 | 4,509,500 | 252,850,000 | 4,781,348 |
| Hydrogen, cu. ft. | 92,757,000 | 639,600 | 137,082,000 | 851,397 |
| Oxygen, cu. ft. | 136,460,000 | 1,791,900 | 131,477,000 | 1,855,911 |
| Sodium hydroxide (for sale), lb. | 133,662,000 | 5,975,000 | 173,021,000 | 6,228,682 |
| Abrasives, aluminous and siliceous lb. | 23,533,000 | 5,500,300 | | |
| Bromine (for sale), lb. | 187,400 | 28,400 | | |
| Calcium carbide, net tons | 69,300 | 7,482,000 | | |
| Ferro-alloys, net tons | 48,500 | 8,835,400 | | |
| Halogen Derivatives (for sale): | | | | |
| Inorganic,[1] lb. | 10,217,500 | 214,100 | | |
| Organic,[2] lb. | 5,289,400 | 777,500 | | |
| Oxidized halogen compounds,[3] lb. | 5,136,500 | 410,800 | ..... | 67,446,750 |
| Peroxide of hydrogen, lb. | 27,296,000 | 2,157,600 | | |
| Peroxides and persalts,[4] lb. | 5,564,000 | 1,204,300 | | |
| Rare metals and alloys,[5] lb. | 1,078,000 | 1,289,400 | | |
| Metals n.e.s. (for sale),[6] lb. | 60,643,000 | 12,197,000 | | |
| Miscellaneous (for sale),[7] lb. | 35,624,000 | 3,211,800 | | |
| Total value | | $58,180,500 | | $82,590,005 |

[1]Hydrochloric acid; sulphur, zinc and iron chlorides, silicon tetrachloride, etc.
[2]Carbon tetrachloride, chloroform, iodoform, bromoform, ethyl chloride, etc.
[3]Sodium iodate, chlorate, bromate, etc.
[4]Peroxide of sodium, of barium, perchlorate of potassium, perborate of sodium, other peroxides, permanganates, persulphates, etc.
[5]Chromium, chromium-cobalt, magnesium, manganese, molybdenum, silicon, silico-manganese, tungsten, vanadium, etc.
[6]Aluminum, aluminum alloys, sodium, phosphorus and compounds.
[7]Sodium cyanide, carbon electrodes, carbon bisulphide, nitrites, oxalic acid, vanadic acid, hypophosphites, etc.

# Letters from Our Readers

**A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute**

## Charging for Reactive Kva.-Hours and Active Kva.-Hours Separately

*To the Editors of the* ELECTRICAL WORLD:

The question is frequently raised: "Would it not be better to have the active component and reactive component of the kva. registered separately and have a different rate for each of them?"

Personally, I do not believe that public service commissions will ever allow such a charge to be made against customers. Public utilities must show costs in nearly every instance as a basis for the price of that which they sell. The cost of producing a reactive volt-ampere-hour is not in any way a fixed figure. For instance, a customer with a small load at 0.707 power factor would carry equal values of reactive kva.-hours and kilowatt-hours; a customer with a larger installation operating, say, at 95 per cent power factor might show the same value in reactive kva.-hours and hence pay the same price as paid by the customer with lower power factor. I do not believe any utility can show that a reactive volt-ampere-hour costs it a definite amount at any time, and certainly it does not represent any useful value to the customer, since the rating of electrical generating substations and distribution equipment is in volt-amperes.

However, a utility can show that with a certain volt-ampere demand a certain percentage of its capacity is tied up, and it can assign to this a definite value. The same is true if the bill is corrected by a power-factor clause which is properly worked out, although the power-factor clause complicates both the calculation of the customer's account and the metering of his load.

R. C. FRYER,
Superintendent Electric Meters.

Union Gas & Electric Company,
Cincinnati, Ohio.

## A Student's Viewpoint

*To the Editors of the* ELECTRICAL WORLD:

I should like to come to the defense of the instructor mentioned in a recent letter in the ELECTRICAL WORLD: "Where the College Instructor Falls Short." At present I am a student of electrical engineering and have had some practical experience in that work. The average man who expects to matriculate into a technical profession realizes that the work given by colleges is very theoretical and that these principles must be applied to the methods and peculiar business conditions of the company which he represents before he can hope for gratifying results. Admitting the large amount of discussion raised by the issue of practical versus theoretical instruction, I believe that for the average student the instructor who can teach the principles involved is more valuable than the man who has had the practical experience but cannot get his ideas across to the student.

A man must obtain his knowledge of the fundamental principles in college if he is to gain a working knowledge of the subject. The practical application can be learned in the business world by actual contact. For this reason, if one of the two must be sacrificed, it is much better to give up the practical side while in school. Most technical schools require a certain amount of practical work and a satisfactory report on it. The student receives more benefit from his personal contact with business than from the practical instructor. It would be an ideal condition, one for which we can hardly hope, if the instructor had had valuable practical experience and was also able to present his subject efficiently to a group of students. Such men are at a premium in the industrial world.

As a student I feel that colleges are sources of knowledge of the principles which we need in our chosen line. It is a question of first getting equipped and then using this equipment most advantageously.

EMMET G. GARDNER.

Ohio State University,
Columbus, Ohio.

## Report on Post Office Illumination Criticised

*To the Editors of the* ELECTRICAL WORLD:

I read with much interest the article entitled "Illumination of Post Offices" published in the March 24 issue of the ELECTRICAL WORLD. I also have a copy of the bulletin issued by the Post Office Department, which I understand from the Office of Industrial Hygiene of the United States Public Health Service is a preliminary report issued by it to the Post Office Department covering work which it has completed on the New York Post Office. I should like to comment on the article appearing in the ELECTRICAL WORLD on this subject as follows:

The specifications for the luminaires for the general workrooms and for the offices is to my mind a very poor one. In the first place, there is no authority for the limitation of brightness at any point not to exceed 2½ cp. per square inch when used with a 200-watt lamp. The flux percentages in the various zones called for in the specification describe very inefficient units of the diffusing type as almost any unit of poor quality could conform to the specifications.

The specifications also state that at least 28 per cent of the bare lamp flux should be emitted in the 0-60-deg. zone and at least 48 per cent in the 0-90-deg. zone, which in substance means that there should be at least 20 per cent of the bare lamp flux emitted in the 0-60-deg. zone. It is a well-demonstrated fact that the light flux in the 60-90-deg. zone is undesirable as it is a cause of glare. In view of this it is evident that the light flux should be limited in the 60-90-deg. zone and that, instead of specifying at least 20 per cent in this zone, the specification should read "not more than — per cent in this zone."

I also note that the luminaires should be in such number and so spaced that the brightness of the units measured in lumens per square foot would not be more than one hundred times as great as the intensity of illumination measured in foot-candles. The number of luminaires used and their spacing would have little effect on the proportion-brightness divided by foot-candles. Furthermore, there is no authority for the figure 100 representing this proportion.

The vertical plane in post office work is quite as important as the horizontal plane. This has not been sufficiently taken into account inasmuch as the specifications for the general workroom and office luminaires

do not include any specific data which would specify illumination on vertical surfaces approximating the illumination on the horizontal surfaces. In fact, luminaires conforming to the specifications would produce illumination intensities on vertical surfaces of approximately one-half those produced on horizontal surfaces.

Regarding the paragraph relating to glare and surface brightness, there are six elements of glare listed and the total flux of light in the angles of 60-90 deg., which is a very important glare factor, has been totally omitted.

If glare is defined as the decrease in the ability of the eye to define objects, there are important data on record which indicate that the brightness of the light source is of little practical effect in producing glare and that the total flux of light which enters the eye is the important factor. Moreover, it has been found that the glare increases as the angle at which this flux enters the eye approaches 90 deg.

The paragraph defining direct, semi-direct, semi-indirect and indirect lighting is very much out of date. At the 1922 convention of the Illuminating Engineering Society Dr. Luckiesh presented a paper on this subject which indicated the common-sense way of defining luminaires as regards their direct and indirect components, and the data given in this paper should by all means be used in any recent literature on the subject.

It is to be hoped that the authors of the "Illumination of Post Offices" will give further thought and study to the subject before issuing their final recommendations as it is customary for the layman to regard data given out from the United States government departments as authoritative, which it should be.

DAVIS H. TUCK,
Electrical Engineer.
Holophane Glass Company, Engineering Department,
New York, N. Y.

## The Specifications for Overhead Lines

*To the Editors of the* ELECTRICAL WORLD:

In the editorial "The Specifications of 1914 are Retired" (page 616 of the March 17 issue of the ELECTRICAL WORLD) are some statements and inferences not quite in accordance with the facts, or at least with certain understandings as to the program to be pursued. It would be unfortunate if the ELECTRICAL WORLD were to cause further misunderstandings of this unhappy subject.

Without going into ancient history as to joint specifications that did not stay "joint," it would be fairer to admit that some rather important interests have never accepted the code as a specification. The status at present is that the code was adopted as an American standard provided that it was to be at once revised by a joint body or sectional committee and, further, that after such revision that body should prepare a specification for crossings. There has been some criticism that it was unusual to adopt an engineering rule subject to an unmade revision, but it has been expected and promised that there would be no attempt to rush the general adoption of the present code as a crossing specification. In the view of the writer it is well to allow the matter to rest, without propaganda from either side and without the adoption by regulatory bodies of any specification, until our sectional committee has had a fair chance to agree on something.

R. D. COOMBS.
R. D. Coombs & Company,
New York, N. Y.

## Easy Solutions to Hyperbolic Functions

*To the Editors of the* ELECTRICAL WORLD:

In view of the growing importance of hyperbolic functions in electrical engineering and the somewhat meager, or at least inaccessible, published information in regard to the computation of the inverse functions, it would seem that material of this kind is of sufficient general interest to warrant publication.

The material is not particularly new, but I have never seen the formulas in this form and believe that they are suitable for presentation in your columns. They were derived by means of Euler's exponential expressions for the sine and cosine, and apply for all values of $u$ and $v$, positive, negative and imaginary.

The last three expressions can be derived in order from the first three by using the reciprocal of $u + jv$ in place of $u + jv$ itself.

The results are:

$$x + jy = \sinh^{-1}(u + jv) = \log_\epsilon[u + jv \pm \sqrt{1 + (u + jv)^2}].$$

$$x + jy = \cosh^{-1}(u + jv) = \log_\epsilon[u + jv \pm \sqrt{(u + jv)^2 - 1}].$$

$$x + jy = \tanh^{-1}(u + jv) = \frac{1}{2}\log_\epsilon\left[\frac{(1 + u) + jv}{(1 - u) - jv}\right].$$

$$x + jy = \operatorname{cosech}^{-1}(u + jv) = \log_\epsilon\left[\frac{1 \pm \sqrt{(u + jv)^2 + 1}}{u + jv}\right].$$

$$x + jy = \operatorname{sech}^{-1}(u + jv) = \log_\epsilon\left[\frac{1 \pm \sqrt{1 - (u + jv)^2}}{u + jv}\right].$$

$$x + jy = \coth^{-1}(u + jv) = \frac{1}{2}\log_\epsilon\left[\frac{(1 + u) + jv}{(u - 1) + jv}\right].$$

For numerical work the third and sixth expressions are particularly convenient. They must, of course, be evaluated by the methods usual in vector work. The positive value of the double sign is used in connection with the others.

As an illustration take the following example:

$$\tanh^{-1}(1.315 + j0.608) = 0.5\log_\epsilon\frac{(1 + 1.315) + j0.608}{(1 - 1.315) - j0.608}$$

$$= 0.5\log_\epsilon\frac{2.315 + j0.608}{-0.315 - j0.608}$$

$$= 0.5\log_\epsilon\frac{2.39\ /14°43'}{0.685/117°23'}$$

$$= 0.5\log_\epsilon 3.49/132°6'$$

$$= 0.5\log_\epsilon 3.49/2.30$$

$$= 0.5\ (\log_\epsilon 3.49 + j2.30)$$

$$= 0.625 + j1.15.$$

Thus:

$$x = 0.625, \quad y = 1.15.$$

Work of this kind is facilitated a great deal by use of a slide rule with a set of scales graduated so that a vector quantity can be transferred quickly from polar to rectangular co-ordinates and vice versa. A number of such rules have been constructed by a leading manufacturer and are quite successful. Such slide rules would be useful also in mechanical engineering and in bridge-design work.

A. F. PUCHSTEIN,
Assistant Professor.
Ohio State University,
Columbus, Ohio.

# Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

## Meter Testing in Maine

METER tests on the system of the Cumberland County Power & Light Company, Portland, Me., include shop tests, periodic and complaint tests. In the first class are included tests on new meters, tests on meters returned from customers' premises and tests on repaired meters. Periodic tests are made on customers' premises according to service requirements, and these include an inspection of the installation with reference to proper metering, the working condition of the meter, connected load and general conditions. This test helps the company's public relations, inasmuch as courteous meter testers afford evidence that the company checks its meters regularly and helps allay the idea that all meters are set fast. Complaint tests are made to remove a customer's suspicions, and these are helpful in securing better conditions on the premises.

At Portland the company has a standardizing set going back to the standard cell by which an indicating laboratory wattmeter is calibrated. Against this wattmeter is calibrated in turn another rotating standard. Using this rotating standard as a laboratory standard, we are able to check our portable rotating standards whenever conditions do not work just right, or else periodically once every week. This laboratory rotating standard is checked every three months to make sure that no conditions have changed it. All calibrations, and especially when the laboratory rotating standard is used, are done by qualified men, and every precaution is taken to prevent overloads or damage to the rotating standard. In this way we feel perfectly safe regarding our standards.

*Meter Testing.*—With reference to meter testing, tests are conducted on single-phase, two-wire meters, single-phase, three-wire meters and polyphase meters. The actual test-

CUMBERLAND COUNTY POWER AND LIGHT COMPANY
PORTLAND, MAINE
METER DEPARTMENT
THE METER MAN CALLED TO METER
AT M AND WAS NOT ABLE TO DO THIS WORK.
PLEASE CALL "4800 – METER DEPARTMENT PLUM STREET" TO ARRANGE FOR HAVING THIS WORK DONE
CUMBERLAND COUNTY POWER AND LIGHT COMPANY
FIG.1
CO. NO. MFG. NO.
CUMBERLAND COUNTY POWER & LIGHT CO. DATE
METER TEST PERIODIC COMPLAINT LABARATORY OFFICE
MAKE TYPE AMPS. VOLTS
WIRE PHASE DIAL R. BILLING R. REG. RATIO
CUSTOMER ADDRESS
METER LOCATION
DATE INSTALLED DATE LAST TESTED
METER READING
HELPER TESTER
FIG.2
TEST K METER READ STAND NO.
AS FOUND CREEP REV MIN
LIGHT FULL VOLTS 1-2 2-3 1-3 AS LEFT
STAND IND. ROTAT COIL AMPS VOLTS REV. REV. FOR 100% OBSERVED REV. WATTS METER SEC REV WATTS INDICATED % ACCURACY AVERAGE % CORRECTED % ACCURACY
NO. OF STANDARD CORRECTION FOR STANDARD 10% LOAD 100% LOAD
REMARKS
FIG.3
RECORD OF TESTS
Date Reason Found Full Load Found 10% Load Left Full Load Left 10% Load Jewel Commutator Top Bearing Seal
FIG.6
CUMBERLAND COUNTY POWER & LIGHT CO.—METER DEPT.
INSTALLERS RECORD OF METERS
DATE
METERS TAKEN OUT OF STOCK
METERS RETURNED—TESTED—REPAIRED AND TESTED AND PUT INTO STOCK
BY
CO. NO. MFG. CO. TYPE SIZE AMP VOLT W PH COST
FIG.4
Mfg'r No. Type Make
Co's. No. Volts Cm
Amps 2 or 3 Wire Phase
Pri. Trans. Ratio Current Trans. Ratio
DATE ORDER NO. NAME STREET & NO. LOCATION METER READING
FIG.6A
METER TEST RECORD.
NO.
MFG. NO
MAKE TYPE AMPS VOLTS
WIRE PHASE DIAL R. BILLING R. REG. RATIO
C. T. AMPS. TYPE NO.
P. T. VOLTS TYPE NO.
ORDER NO. COST NUMBERED BY
DATE RECEIVED TESTED BY
DATE TESTED READING FOUND LEFT
TEST K-METER STAND
CREEP REV MIN
NON INDUCTIVE AS FOUND AS LEFT
LIGHT FULL LIGHT FULL
STAND COIL LAMPS VOLTS REV. (100%) OBSERV. REV. METER SEC REV WATTS IND. % ACC. AV. & COR. % ACC.
NO. STANDARD CORRECTION FOR STANDARD 10% LOAD 100% LOAD
FIG.8
PURCHASE ORDER NO.
PURCHASED FROM
SIGNED
CUMBERLAND COUNTY POWER & LIGHT COMPANY
METER DEPARTMENT
A. M. P. M. DATE 192
THE FOLLOWING SERVICE ORDERS HAVE BEEN CONNECTED.
SERVICE ORDER METER ORDER SERVICE INFORMATION CURRENT VOLTS WIRE PHASE CONNECTED BY
FIG.5
Cumberland County Power & Light Co.
METER DEPARTMENT
NAME
ADDRESS
WE COULD NOT INSTALL THE METER
ON DATE
BECAUSE
WE SUGGEST THAT THIS BE IMMEDIATELY TAKEN UP WITH YOUR ELECTRICAL CONTRACTOR TO HAVE THIS CHANGED ON COMPELTION PLEASE CALL—4800, METER DEPT.—NOTIFYING US THAT THE CHANGE HAS BEEN MADE
Cumberland County Power & Light Co.
PER
FIG.7

TYPICAL FORMS EMPLOYED BY ONE COMPANY FOR KEEPING ITS METER RECORDS

Fig. 1—Form to show that meter installer was at premises but was unable to get in.

Figs. 2 and 3—Subsequent test record. Fig. 3 printed on back of Fig. 2.

Fig. 4—Form used as a check of meters taken out or returned by meter installers.

Fig. 5—Record of services as reported by service department.

Figs. 6 and 6A—Meter record card. Gives the complete history of the meter. Fig. 6A printed on back of Fig. 6.

Fig. 7—Form used when wiring is defective or rules have not been followed.

Fig. 8—Original record of shop tests.

ing on all meters is the same. The tester always notes the general condition of the meter and its surroundings, especially meter seals and evidences of tampering. He checks coils, bearings, rusting of the meter, the position of the magnets, the position of light-load adjustment, creeping and anything wrong that should be corrected. The single-phase two-wire and three-wire meters are used on house service and are tested non-inductively, although with the type of appliances that is beginning to be used by houses it may be well to have the power-factor adjustment within 4 per cent. Where a single-phase meter, however, is used for power, as on single-phase motors, just as much care should be used on the power-factor adjustment of this meter as on a polyphase meter. In our own case the 220-volt, two-wire meters used for this purpose are adjusted for power factor.

In the polyphase meter we have a different condition and the method of testing has to be well looked into. All polyphase meters are tested with coils in series. To check correctness in doing this a series of tests were run of a polyphase meter on polyphase load against two single-phase rotating standards. These tests proved that the meter on polyphase load has the same accuracy as the meter with coils connected in series. Testing each element separately is liable to make the meter fast. The routine of testing a polyphase meter is as follows:

ROUTINE TESTING OF METERS

The potential coils are connected in parallel and the current coils in series but bucking so as to make one element rotate backward. The electric elements are moved in or out from the shaft till no tendency to rotate is apparent. The meter is then reconnected, coils in series, and adjusted for 100 per cent non-inductive load.

*Power-Factor Test.*—Leaving the meter as connected for the unity-power-factor test and throwing the potential on the other phase will immediately give a power-factor test. If the meter is found off, each element is tested separately to see where the error lies. This element is then adjusted to bring the power-factor accuracy to 100 per cent, after which the meter is rechecked with the coils in series.

The question of power factor is becoming of primary importance, and a discussion as to various methods of power-factor tests and as to what should be done with reference to power factor would be of value. Another method is, instead of checking power factor at 50 per cent, to check a meter as low as 20 per cent or 30 per cent power factor.

On alternating-current meters the light-load test should be made around 5 per cent load. This is done to prevent creeping. Alternating-current meters have a very rapid percentage accuracy curve upward with decreased load, and should a meter be set accurate at 10 per cent load it may creep, owing to the high overcompensation. Full load should be taken at points above 75 per cent load.

*Meter Records.* — For keeping records of meter tests we have a general system of folders and test cards. These folders contain all data on the meters together with the original shop test. As subsequent tests are then made on the same meter these tests are recorded either on a stiff card for outside tests or on the lightweight form for shop tests. Every test made on a certain meter is put into this folder, giving a complete record of all work done on that particular meter.

The tests are also recorded on the meter record so that by taking out this card the various periods of tests, together with the accuracy found, can be used to determine how often this meter should be tested. The meter-record cards have various colors which designate the type of installation, giving an idea of the importance of the meter. These colors are as follows: White — 5-amp. watt-hour meters, single-phase; red — alternating-current single-phase meters from 10 amp. up and self-contained and alternating-current polyphase meters; blue—meters either used with current or potential transformers or both; buff—direct-current meters.

H. BURGI, JR.,
Meter Department,
Cumberland County Power & Light Company,
Portland, Me.

# Extracts from an Operating Code

BY FIELD EDITOR ELECTRICAL WORLD
New York, N. Y.

## Induced-Draft Fans

WHEN starting forced-draft fans, the stack draft damper should be closed to enable the fan to start under minimum load and also to enable the boiler operator to make proper adjustments more readily than if the dampers were left open. The following instructions, as abstracted from the operating code of the Philadelphia Electric Company, pertain to starting and shutting down induced-draft fans:

STARTING

1. See that the stack damper is closed.
2. Turn on the cooling water to the bearings.
3. Start the turbine or motor.
4. See that the oil rings are operating and supplying oil to the bearings.
5. Bring the unit up to speed.
6. Inspect the unit for excessive vibration and, if excessive vibration is discovered, report the trouble to the shift superintendent.
7. If the main oil switch (controlled at the boiler operating boards) should trip, have an inspection made by the electrical mechanic and any trouble corrected before closing it again.

SHUTTING DOWN

1. Shut down the turbine or motor.
2. Shut off the cooling water from the bearings.
3. Close the induced-draft dampers (or bypass the induced-draft fan).

## Testing Overspeed Devices

TESTING overspeed devices on rotary converters and motor-generators should be done under the direct supervision of the substation supervisor or foreman, according to the operating code of the Philadelphia Electric Company. This test can only be made when the machines being tested are running in parallel with another source of direct current.

The following instructions for testing overspeed devices as abstracted from the operating code referred to above should prove of value to any one making these tests:

1. Disconnect or block the reverse-current trip.
2. Adjust the field rheostat so that the speed will remain close to normal (about unity power factor or slightly leading); open the oil switch, leaving the direct-current switches and circuit breakers closed and the neutral switch open.
3. Cut in the field resistance slowly, observing the speed of the machine with a tachometer, until the overspeed device opens the circuit breakers (not exceeding 15 per cent above normal speed).
4. Observe the speed at which the overspeed device operates; this speed should be about 10 per cent above normal.
5. If the device does not operate at this speed, make adjustments and repeat the test.

# Signposts of Steam Plant Economy

WITH the advent of boilers built to operate on 650 lb. pressure and corresponding advances in the design of prime-mover equipment, expected total plant efficiencies will closely approach the record of the Diesel engine. This statement was made by E. F. English, chief engineer General Engineering & Management Corporation, New York, at a recent meeting of utility managers of the organization. Boilers are now being installed to operate at 525 lb., and today turbo-plants are operating at 350 lb. and more than 700 deg. steam temperature. Plants are now operating on powdered coal at monthly boiler efficiencies of 82 to 84 per cent. The speaker held that within ten or fifteen years all coal under the larger boiler plants will be burned in powdered form. The supply of fuel oil is relatively limited, known deposits embracing only fifty years' requirements against several hundred years' coal resources.

TABLE I—HEAT LOSSES IN AN AVERAGE BOILER ROOM

| How Lost | Per Cent of Heat in Coal |
|---|---|
| 1. Handling at plant | 1.0 |
| 2. In ash | 3.9 |
| 3. By radiation | 2.9 |
| 4. By incomplete combustion | 0.7 |
| 5. On account of air leakage in furnace and boiler | 9.8 |
| 6. On account of excess air through gates | 9.8 |
| 7. Because of short-circuiting of gases in gas passages of boiler | 1.1 |
| 8. From soot on heating surface | 3.9 |
| 9. From scale in boiler | 5.0 |
| 10. Because of incorrect amount draft for load | 3.8 |
| 11. Because of leakage of water and steam | 0.7 |
| Total preventable or reducible losses | 42.6 |

The preventable losses in boiler plants of average rating are shown in Table I. These preventable losses are seldom below 25 per cent in medium-sized boiler plants. Important gains in economy in late years have resulted from the use of higher settings. In the speaker's practice, the front header is set from 10 ft. to 15 ft. above the floor. Tight furnace walls, unwarped baffles, unburned baffles and tubes free from soot are essential to efficient operation. Inadequate draft has caused poor efficiency in many cases, although excess air beyond combustion necessities is even worse. The losses resulting from excess air for combustion are shown in Table II. Scale in tubes is also a source of waste, $\frac{1}{8}$-in. scale causing a loss of 12 per cent in heat transmission.

TABLE II—RELATION BETWEEN EXCESS AIR, $CO_2$ AND FURNACE TEMPERATURE

| Per Cent of $CO_2$ in Flue Gas | Pounds of Air per Pound of Fuel | Fire Temperature, Deg. F. | Approximate Percentage of Excess Air | Fuel Tonnage, Per Cent |
|---|---|---|---|---|
| 20 | 12 | 3,910 | 9 | 11 |
| 16 | 15 | 3,190 | 36 | 12.5 |
| 13.4 | 18 | 2,700 | 64 | 15 |
| 11.4 | 21 | 2,340 | 91 | 17.5 |
| 10 | 24 | 2,060 | 118 | 20 |
| 8.9 | 27 | 1,850 | 146 | 22.5 |
| 8 | 30 | 1,680 | 173 | 25 |
| 7.3 | 33 | 1,535 | 200 | 27.5 |
| 6.7 | 36 | 1,415 | 227 | 30 |
| 6.2 | 39 | 1,315 | 254 | 32.5 |
| 5.8 | 42 | 1,225 | 282 | 35 |
| 5.0 | 48 | 1,085 | 336 | 40 |

The chief item entering into the cost of power production is fuel. It is probable that the boiler-room foreman can save or waste more money than any other man in the plant organization. Cheap labor in the boiler room is the most expensive help available. Table III shows the proportion of fuel costs to total in a group of seven plants.

Care in fuel selection from the standpoint of heat content per unit of cost, the use of adequate indicating and recording instruments, attention to vacuum and feed-water heating, all are needed in the campaign for plant efficiency. The heat in a pound of coal from various mines may vary as much as 100 per cent, against a maximum of 8 per cent in fuel oil over a wide range of gravity. Roughly, 1 per cent of fuel is saved for each 11-deg. increase in feed-water temperature. The variation of an inch in vacuum at the exhaust end of a modern steam turbine may change the water rate by 1 lb. Boiler-feed pumps should have at least 10-ft. head on the hot-water suction inlet, and the formation of scale or sludge in condenser tubes seriously impairs heat transmission and should be checked by inspection and temperature records.

## Instruments and Records

Instruments for boiler and engine room operation have been sadly neglected till quite recently, and even now a large amount of steam is generated with the aid of no other instruments than a steam gage and gage glass. The instruments which tend to give us a strong grasp on varying conditions are really signposts on the road to economy, and when properly used are worth-while investments.

Among these most deserving of installation are a draft gage connected so as to read furnace, ash-pit and uptake pressures and the drop through the boiler; a pyrometer to read flue-gas temperatures, one instrument being so connected as to serve a number of boilers; the $CO_2$ recorder or, where expense prevents, an Orsat; a thermometer in the feed line, some method of determining the weight of coal and ash, and a steam-flow meter is also desirable.

By the use of the indicator varying conditions in engine operation can be detected and corrections made. The vacuum gage, preferably a mercury column, and thermometers for indicating the inlet and discharge temperatures of the condenser circulating water are of great assistance in the efficient operation of the condenser and its auxiliaries.

Only useful records should be kept. Some operators require power-plant employees to keep many records, most of which are filed away and never consulted afterward. The chart form is much better than a column of figures in emphasizing changes in conditions. It is of primary importance that an accurate record should be kept of output and fuel. A continuous record of fuel burned, water evaporated and output is of far greater value in showing production costs and condition of equipment than any spasmodic tests of apparatus no matter how thorough. Important boiler-room records con-

TABLE III—ELEMENTS OF PRODUCTION COST IN PERCENTAGE OF TOTAL

Plants Nos. 1, 3 and 5 are oil-burning and have 705,570, 1,604,430 and 1,710,410 kw.-hr. yearly output respectively. Plants Nos. 2, 4 and 6 are coal-burning and have 681,230, 2,208,220 and 4,247,400 kw.-hr. yearly output respectively. Plant No. 7 gives an average type of large-power-plant operation with an approximate average yearly output of 79,000,000 kw.-hr. The figures are for the twelve months ended Dec. 31, 1922.

| Plant: | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Fuel | 51.2 | 61.8 | 67.9 | 68.7 | 70.4 | 75.0 | 69 |
| Labor | 29.5 | 18.8 | 11.0 | 19.4 | 17.9 | 17.4 | 18 |
| Maintenance | 15.8 | 14.3 | 17.3 | 6.7 | 8.1 | 3.5 | 9 |
| Miscellaneous | 3.5 | 5.1 | 3.8 | 5.2 | 3.6 | 4.1 | 4 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

cern quantity and temperature of feed water, boiler pressure, draft and temperature of gases leaving boiler; time of cutting in and cutting out boilers, and when and how long boilers were blown down. Important engine-room records are on load carried, vacuum, temperature of circulating water entering and leaving condenser, and hot-well temperature. Time of starting and stopping units should also be recorded.

Much of the foregoing, in a general way, applies also to Diesel plants, gas plants and ice plants.

The Diesel engine requires careful maintenance and attention to details. In general, after a certain time has elapsed, inspection should be made to see whether attention is required, and at intermediate times, if there is any indication of the improper functioning of any part, investigation should be made and such maintenance work as is necessary done. For proper maintenance a chart should be made up on which are listed all parts of the engine that require attention, and for each item an estimate should be made as to how often it should be inspected. Notes should also be made of the condition on previous inspection. Of course, the lubricating and cooling system requires constant supervision. As one manufacturer has said, "The lubricating system is the heart of the Diesel engine."

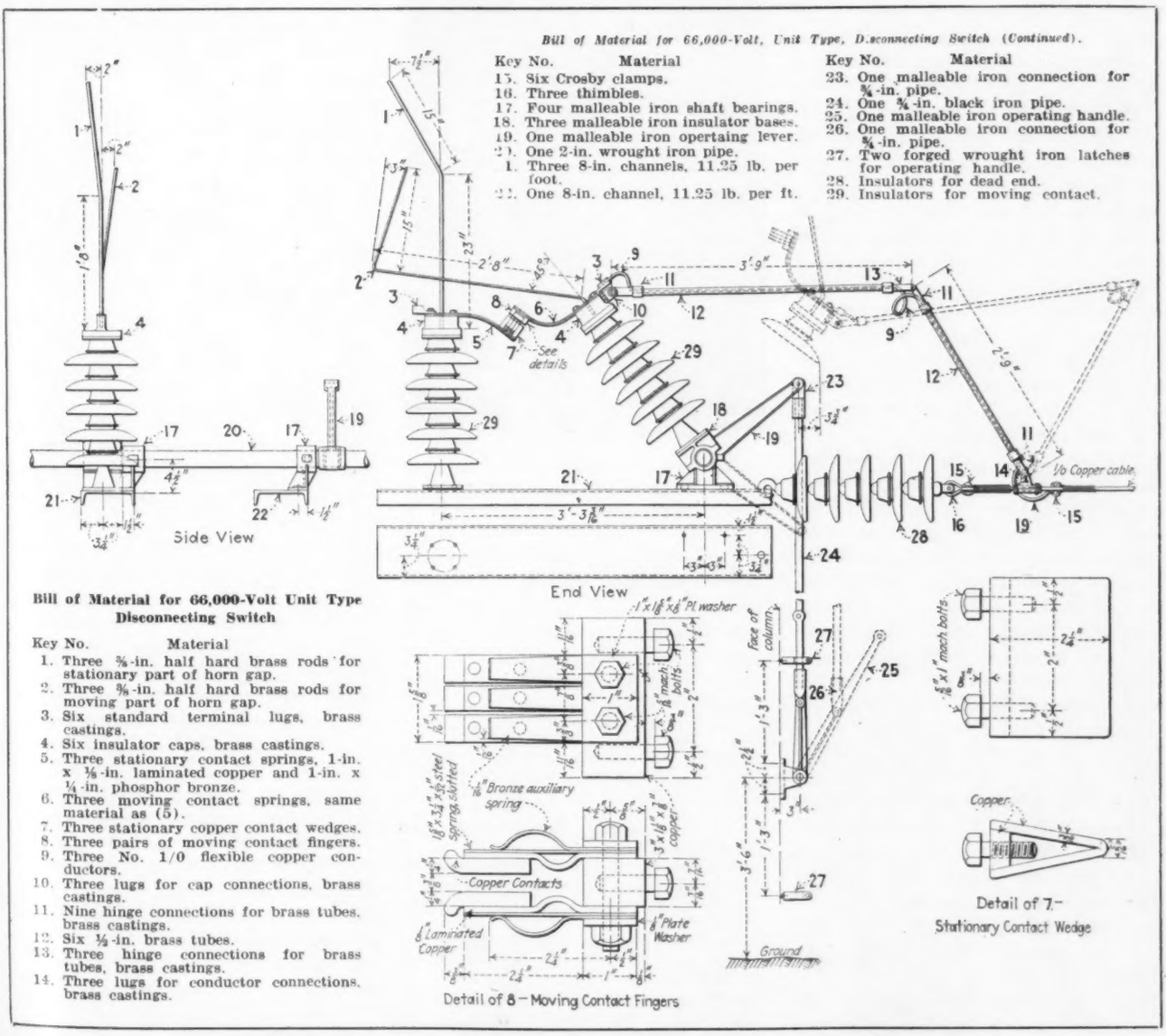
FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

## Tennessee Company's New "Disconnect"

WHEN poles settle, most of the disconnecting switches which the Tennessee Electric Power Company has used up to this time tend to get out of alignment. Furthermore, most of these switches require four poles and more than two insulators per phase. To eliminate these and other objections the company has developed the rocking type of "disconnect" shown, which requires only two poles for mounting and which has the advantage of not getting out of alignment easily.

It may be observed that one insulator per phase is fixed and supports one end of the line, a stationary contact and an arcing horn. The other insulator rocks about a horizontal axis, carrying with it the movable contact and an arcing horn. Connecting it with the other terminal of the line is a jack-knifing tube which contains a flexible lead, this being hinged at both ends and the middle.

E. C. WILLIAMSON,
Electrical Engineer.
Tennessee Electric Power Company,
Chattanooga, Tenn.




**Bill of Material for 66,000-Volt Unit Type Disconnecting Switch**

| Key No. | Material |
|---|---|
| 1. | Three ⅜-in. half hard brass rods for stationary part of horn gap. |
| 2. | Three ⅜-in. half hard brass rods for moving part of horn gap. |
| 3. | Six standard terminal lugs, brass castings. |
| 4. | Six insulator caps, brass castings. |
| 5. | Three stationary contact springs, 1-in. x ⅛-in. laminated copper and 1-in. x ¼-in. phosphor bronze. |
| 6. | Three moving contact springs, same material as (5). |
| 7. | Three stationary copper contact wedges. |
| 8. | Three pairs of moving contact fingers. |
| 9. | Three No. 1/0 flexible copper conductors. |
| 10. | Three lugs for cap connections, brass castings. |
| 11. | Nine hinge connections for brass tubes, brass castings. |
| 12. | Six ½-in. brass tubes. |
| 13. | Three hinge connections for brass tubes, brass castings. |
| 14. | Three lugs for conductor connections, brass castings. |

*Bill of Material for 66,000-Volt, Unit Type, Disconnecting Switch (Continued).*

| Key No. | Material |
|---|---|
| 15. | Six Crosby clamps. |
| 16. | Three thimbles. |
| 17. | Four malleable iron shaft bearings. |
| 18. | Three malleable iron insulator bases. |
| 19. | One malleable iron opertaing lever. |
| 20. | One 2-in. wrought iron pipe. |
| 21. | Three 8-in. channels, 11.25 lb. per foot. |
| 22. | One 8-in. channel, 11.25 lb. per ft. |
| 23. | One malleable iron connection for ¾-in. pipe. |
| 24. | One ¾-in. black iron pipe. |
| 25. | One malleable iron operating handle. |
| 26. | One malleable iron connection for ¾-in. pipe. |
| 27. | Two forged wrought iron latches for operating handle. |
| 28. | Insulators for dead end. |
| 29. | Insulators for moving contact. |

ROCKING-TYPE "DISCONNECT" DEVELOPED BY TENNESSEE COMPANY FOR 66,000-VOLT LINES

## Strength of Wood Poles Not Affected by Perforating

THAT the exact loss of strength due to the perforation of wood poles to insure better penetration of the preservative oils is not of sufficient importance to justify the making of strength tests unless an unusual opportunity arises is the conclusion of a committee of the American Wood Preservers' Association, which presented a report at a recent convention in New Orleans. The committee said that theoretical loss of strength had been determined as being a function of the depth of the holes and the maximum percentage of the circumference cut in a horizontal plane, and it was of opinion that the recognition of this principle gives the essential information and that the only value of making strength tests is to check the actual and theoretical strength losses. The committee is expected to continue consideration of the subject, making tests if the proper opportunity offers.

The committee also asserted that no improvement in the perforating patterns now in use can be made until greater knowledge is gained as to seasoning and its effect or that of other unknown factors upon the oil travel. No conclusion was reported on the study of the committee to determine the effect of seasoning on penetration and whether it would be possible to classify poles as to condition of seasoning and then find a way quickly and accurately to identify such classifications.

The committee's study showed that the effect of the perforated treatment is to prevent harmful checking and to a marked degree to close checks which are in the timber at the time of treating. The non-perforation treatment does not prevent checking in green timber, but lessens the checking in partially seasoned or seasoned timber. The report further said that perforation without the treatment lessens checking to a greater extent than the non-perforation treatment. The experiments on which the conclusions were based were carried on at St. Paul, and the committee thought that results in other latitudes might vary. An investigation of the records of representative pole lines with perforated and unperforated poles is being made.

The committee on pressure treatments continued its work in the examination of the life history of full-cell process-treated poles and submitted some tentative full and empty process-treatment specifications and also information on empty-cell treated pole lines in Europe. Hundreds of thousands of poles are reported to have been treated by this process and erected in England with no cases of failure as yet brought to the attention of telephone and telegraph officials.

FIELD EDITOR ELECTRICAL WORLD.
Chicago, Ill.

## Small Parts Heat Treated Electrically for 0.33 Cent per Pound

RECENTLY the engineers of the Royal Typewriter Company, Inc., Hartford, Conn., were confronted with the problem of producing slide rails for their product which would withstand indefinite wear. These pieces are of such shape that ordinary methods of carburizing, such as coal-fired or gas-fired furnaces, were unsuccessful owing to the distortion from uneven heating. After a study

NOT A SINGLE FAULTY HEAT TREATMENT HAS OCCURRED IN FIRST HALF YEAR'S OPERATION OF THIS FURNACE

of the available apparatus a Hagan electric furnace was installed, and this has operated for more than six months without the discovery of a single faulty heat treatment.

The furnace specifications called for the following service:

Heat treatment: Case hardening.
Material to be hardened: Drop-forged steel, 10-point to 20-point carbon.
Estimated weight of pieces per heat: 225 lb.
Estimated weight of containers per heat: 775 lb.
Estimated weight of compound: 90 lb.
Total weight of parts to be case-hardened per week of fifty hours: 3,750 lb.
Dimensions of containers, approximate: 15 in. x 7 in. x 12 in. deep, outside.
Electrical supply available: 220-volt, 60-cycle, two-phase energy.
Furnace temperature required: 1,650 deg. F.

To meet these requirements the furnace built has a working chamber 4 ft. 10½ in. long x 3 ft. wide x 1 ft. 11 in. high and a connected load of 60 kw. The insulating walls are 9 in. thick and the door specially insulated. A view of the furnace is shown herewith. Leeds & Northrup full automatic control was utilized, and the thermocouple is mounted directly above the work in the front center of the furnace. Alloy pots are used.

Five to six hours are required for the furnace to attain its operating temperature of 1,650 deg. F. when starting cold. The work is then placed in the furnace and the temperature falls to about 1,100 deg. F. After this about one and a half hours is required to bring the charge up to 1,650 deg. F. A six-hour bake produces the desired penetration of thirty to forty thousandths of an inch. To every rail is given a Rockwell hardness test.

A production of fifteen heats per week is the regular schedule. This consists of: Work, 2,475 lb.; charge, 3,300 lb.; pots, 11,940 lb.; total, 17,715 lb. The total consumption of electricity for a week's run is 3,500 kw.-hr. The cost per pound of actual work done is 2.38 cents, or 0.33 cent per pound of total charge.

Temperature readings show that the furnace walls average only about 150 deg. F. except around the door and at the point where the leading-in cables enter the furnace walls. The radiation loss is about 6 kw. A rough comparison with a coal-fired furnace having two compartments 2 ft. wide x 5 ft. long showed that the fuel expense was slightly less than the electrical cost, but the cost of handling coal and ashes brought the total cost per pound of work carburized about to the level of the electrical cost. With electric heating there is no guesswork as to temperature conditions on the part of the operator and high quality is assured.

H. W. DERRY,
Power Engineer.
Hartford Electric Light Company,
Hartford, Conn.

# Central Station Business

**Advertising, Selling and Service Methods**
**Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences**

## A Survey of the Appliance Load*

### Investigation of Three Groups of 270 Residences in Chicago Indicates that Household Devices Account for Approximately 20 per Cent of Energy Used in Homes

By H. B. Gear
Commonwealth Edison Company, Chicago

THE use of household appliances has for some years been encouraged by central-station men who have seen in such devices a means of increasing the revenue derived from the residence customer. To determine just what this business meant to the company in energy consumption and revenue the Commonwealth Edison Company recently made a survey of a number of typical residences of various classes.

#### Plan of the Survey

The customers chosen were selected to form three groups of about 270 each, classified as "above medium," "medium" and "below medium." The "medium" group was selected on the basis of the average kilowatt-hour consumption per year of all residence customers and on the general character of buildings as regards rental values. This group consisted of 119 houses and 158 apartments whose average annual consumption was 367 kw.-hr. The "above medium" group consisted of 75 houses and 147 apartments with an annual consumption of 525 kw.-hr. The "below medium" group included 85 houses and 229 apartments, with an annual consumption of 216 kw.-hr. Each of these 813 customers was interviewed by two census takers, one to inspect lamp and appliance ratings and one to fill out a very complete record sheet.

The customers were selected in groups supplied by a separate transformer installation. Curve-drawing meters were used to get from each such transformer the load records of the group for seven consecutive days. In order to obtain data as to energy consumption of different appliances, records were taken of six to eight of each group for seven days from a meter set on the premises. The co-operation of customers was readily obtained by presenting them with an electrical appliance to compensate for their trouble.

*Abstract of a paper given before the Illinois State Electric Association, March 15, 1923.

TABLE I—STATISTICS OF AVERAGE RESIDENCES SURVEYED

| | Houses | | | Apartments | | |
|---|---|---|---|---|---|---|
| | Above Medium | Medium | Below Medium | Above Medium | Medium | Below Medium |
| Number surveyed | 75 | 119 | 85 | 147 | 158 | 229 |
| Number of rooms | 12.3 | 8.5 | 6.9 | 10.3 | 8.9 | 5.8 |
| Number of persons per residence | 4.5 | 4.2 | 4.3 | 3.4 | 3.8 | 2.7 |
| Annual kw.-hr. | 556 | 324 | 219 | 508 | 399 | 215 |
| Connected load, watts: | | | | | | |
| Lamps | 1,366 | 738 | 547 | 1,068 | 821 | 500 |
| Appliances | 1,191 | 773 | 519 | 1,026 | 756 | 698 |
| Number lamps per residence | 26.9 | 13.6 | 9.4 | 20.3 | 15.0 | 9.0 |
| Per cent residences having no appliances | 2.7 | 9.2 | 18.9 | 3.4 | 4.4 | 6.6 |

The number and general characteristics of the residences surveyed are given in Table I. It will be seen that there are considerable differences between the various classes as regards the size of the residence, the number of persons in the family and the energy consumption. It is of interest to note that the connected load in appliances exceeds that in lamps in most cases.

The data from the census of appliances are presented in Table II. The number of appliances per 100 residences is indicative of the degree of saturation reached with the various devices. The flatiron is easily the leader, as it constitutes about 40 per cent of the total number of appliances found, the vacuum cleaner and toaster being next in order, with 18 per cent and 13 per cent respectively. The washing machine is 8 per cent, the percolator 6 per cent and all other devices are 14 per cent of the total found. Two thousand and five appliances were found in 813 houses, or 2.4 per residence. The washing machine is not as generally found in apartments as in houses, and this is true to a less extent with vacuum cleaners, but the reverse is true with the toaster.

From the test charts the hourly kilowatt-hour consumption by lamps and appliances was determined and the consumption of the various ap-

TABLE II—CENSUS OF APPLIANCES

| | No. per 100 Residences | | Per Cent Not Ordinarily Used | | Per Cent Residences Having No Appliances of Stated Kinds | |
|---|---|---|---|---|---|---|
| | Houses | Apts. | Houses | Apts. | Houses | Apts. |
| Flatirons: | | | | | | |
| Above medium | 106.8 | 111.5 | 3.7 | 6.1 | 4.0 | 3.4 |
| Medium | 88.2 | 98.1 | 3.8 | 5.8 | 12.6 | 6.3 |
| Below medium | 78.8 | 93.0 | 1.5 | 3.3 | 21.2 | 7.0 |
| Vacuum cleaners: | | | | | | |
| Above medium | 82.7 | 64.6 | 6.5 | .... | 20.0 | 35.4 |
| Medium | 42.8 | 51.3 | ..... | 6.2 | 57.2 | 48.7 |
| Below medium | 21.2 | 29.3 | ..... | 3.0 | 78.6 | 70.7 |
| Washing machines: | | | | | | |
| Above medium | 62.7 | 14.3 | 4.3 | 14.3 | 37.3 | 85.7 |
| Medium | 46.2 | 8.2 | 7.3 | 15.4 | 53.8 | 91.8 |
| Below medium | 25.9 | 6.5 | ..... | 13.3 | 74.2 | 93.2 |
| Toasters: | | | | | | |
| Above medium | 41.3 | 51.7 | 12.9 | 17.1 | 61.3 | 49.0 |
| Medium | 21.0 | 31.0 | 24.0 | 26.5 | 80.8 | 70.3 |
| Below medium | 3.5 | 34.1 | 33.3 | 15.4 | 96.5 | 65.9 |
| Percolators: | | | | | | |
| Above medium | 28.0 | 27.2 | 42.9 | 27.5 | 73.3 | 73.0 |
| Medium | 12.6 | 16.5 | 53.3 | 57.7 | 87.5 | 84.3 |
| Below medium | 1.2 | 11.8 | 100.0 | 63.0 | 98.9 | 88.0 |

TABLE III—COMPARISON OF ESTIMATED AND COMPUTED CONSUMPTION

| | Annual Kw.-Hr. Used by Appliances | |
|---|---|---|
| | Estimated | Test Week × 50 |
| Flatirons: | | |
| Houses | 63 | 94.2 |
| Apartments | 48.5 | 69.7 |
| Vacuum cleaners: | | |
| Houses | 6.2 | 7.8 |
| Apartments | 4.8 | .... |
| Washing machines: | | |
| Houses | 23 | 32.8 |
| Apartments | 22.3 | .... |
| Toasters: | | |
| Houses | 16.5 | 18.5 |
| Apartments | 16.7 | 18.1 |
| Percolators: | | |
| Houses | 21 | 25.7 |
| Apartments | 22.7 | .... |

pliances was then segregated. The use of appliances, while heaviest on Tuesday owing to the ironing load, was remarkably well distributed through the other days of the week. The appliance consumption expressed as a percentage of the total consumption during this week was: "Above medium" houses, 44; "medium" houses, 37; "below medium" houses, 41.1. "Above medium" apartments, 26.9; "medium" apartments, 19.1; "below medium" apartments, not tested.

If it be assumed that 15 per cent of all houses served are "above medium," 45 per cent are "medium" and 40 per cent are "below medium," the weighted average of energy used for appliances by houses during the test week would be 41 per cent and for apartments 21 per cent of the total consumption.

The monthly variation of energy consumption is such that during the month of May the total consumption is about 75 per cent of the average for the year. In the case of the houses tested this would mean that if the appliance consumption is 41 per cent during May, it would average about 75 per cent of that amount, or 30 per cent, for the year. In the apartments tested it would be about 16 per cent for the year. In connection with the survey each customer was questioned as to the use of the various appliances in different months of the year. These customer estimates averaged about 20 per cent for houses and 14 per cent for apartments. This leaves a discrepancy between the 30 per cent for houses computed from tests and the 20 per cent obtained from estimates made after talking with the customer. In the case of apartments the figures of 16 per cent for the test and 14 per cent for the survey are in practical agreement. The difference in the case of houses may be attributable to a disposition to underestimate or to the possibility that seasonal variations in use of appliances are greater than was assumed in the calculations. It is probable that the correct figures for yearly appliance consumption for houses is between 20 per cent and 25 per cent.

The consumption of energy by the various appliances as computed from the joint estimates of customer and surveyor appears in Table III. In the same table is given the consumption of the same appliances as measured in the houses tested for one week multiplied by fifty to give a figure approximating annual consumption if the use of appliances is the same throughout fifty weeks of the year. Two weeks have been allowed for the customer's absence from home because of vacation or for other reasons.

An application of the data obtained to the Chicago residence rates and average consumption reveals an annual appliance use of about 68 kw.-hr. by the average customer, which adds about $2.75 per year to his bill. With a total of 500,000 residence customers, this adds $1,375,000 per year to a gross residence revenue of about $10,000,000, which is sufficient to make this class of business desirable to the company.

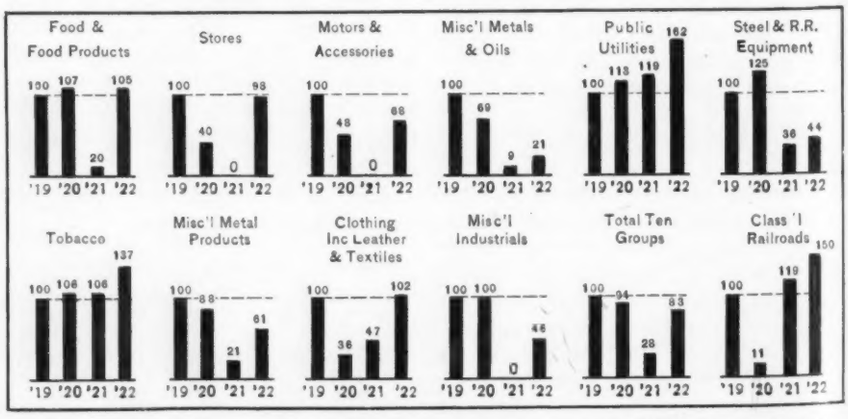
# Moody Classes Public Utility Securities as Most Desirable Investment

PUBLIC utility securities are now considered by high financial authorities as one of the most desirable forms of investment, and the reasons for this favorable opinion are stated concisely by John Moody, president of Moody's Investors' Service, who, in a recent special analysis of the public utility field, says:

"We have come to regard public utility securities taken as a whole as the most desirable and attractive class in the investment market today. More favorably and intelligently regulated than the steam railroads, fundamentally more stable in every respect than the average industrial enterprise, the public utilities of the country face an assured future confronted by one great problem—to finance expansion of their facilities rapidly enough to take care of the steadily increasing volume of business offered them."

"It is evident," Mr. Moody goes on, "that the power companies represent one of the most important and most stable of the basic industries; that their future, simply on the basis of past accomplishment, is definitely assured for a considerable time to come, and that well-placed mortgage bonds of the strongest of these companies may be freely classified among the highest grade of investment securities."

That the securities of these companies combine to a marked degree safety and stability, factors of prime importance to the investor, is shown




ANNUAL NET PROFITS OF 122 MANUFACTURING AND MERCHANDISING CONCERNS AND OF THE CLASS 1 RAILROADS (1919 PROFITS = 100 PER CENT)

in the accompanying chart from the March "Monthly Review" of the Federal Reserve Bank of New York. It represents graphically business profits for ten groups of industries in the years 1919-1922 inclusive. In this respect the public utilities stand head and shoulders above the other nine groups, a direct reflection of the fundamental soundness of the industry.

Either in good times or bad there is always a demand for electric light and power because these services are indispensable both to cities and rural communities, to individual householders and to large corporations. Thus the earnings of well-managed public utility companies are safeguarded by the very necessity of the service rendered.

## Promoting Rural Service in France

DEVELOPMENT of rural service in France is presenting much the same problems to the central-station companies there as it is in this country. Different methods of promoting the use of electricity by farmers have been tried, and a particularly interesting program that is in use by one company and might be used in similar form in this country has been described by William W. Brunswick, American Consul at La Rochelle.

To encourage the use of electrical energy in rural communities of that district where a certain prejudice exists against its use, the electric power company has been giving lectures upon the utility of electricity to the farmers and country people in general. The company has sent a circular letter to all possible users of electricity in the rural districts and has also published it in the local newspapers. The contents of this circular explain the many usages to which electricity can be applied on the farm, in the home and in farm buildings and are as follows:

1. *What One Can Do with a Kilowatt-Hour of Light*:

Economize 4 liters (1.05 gal.) of kerosene.

Illuminate during twenty-five hours the kitchen, the halls, the cellar, the blacksmith shop and the carriage house, a stable for twenty cows, a stable for sixteen horses, a sheepfold for 100 sheep, a hogpen for thirty hogs, a granary of 300 sq. m. (359 sq. yd.), a carriage house or harness room of 60 sq. m. (72 sq. yd.) a dairy of 40 sq. m. (48 sq. yd.), a shed of 100 sq. m. (119 sq. yd.)

Sew with a sewing machine during twenty hours.

Clean fifteen knives during one year.

Clip five horses or twenty-five sheep.

Heat water for shaving each morning during one month.

Light a cigar after each meal during five years.

Iron during four hours.

Warm your bed during four nights.

Heat your room during one hour.

Bring to a boiling point 9 liters (2.37 gal.) of water.

Fry fifteen chops in fifteen minutes.

Warm a coffee pot or dishes during five meals.

Warm your feet during ten hours.

Curl your hair each morning for twenty days.

Incubate 250 eggs.

2. *What One Can Do with a Kilowatt-Hour of Power*:

On the farm: Work an are (120 sq. yd.) to a depth of 30 cm. (11.81. in.); work two ares (240 sq. yd.) to a depth of 22 cm. (8.66 in.); work three ares (360 sq. yd.) to a depth of 15 cm. (5.90 in.); plough up the stubble of 4 ares (480 sq. yd.); illuminate the farm during two hours; irrigate a hectare (2½ acres) during fourteen hours with 3.50 m. (3.82 yd.) elevation.

In the barn: Thresh 140 sheaves of wheat of 3,500 kg. (7,716 lb.); illuminate the thrashing room during five hours.

In the dairy and cow barn: Milk with a machine twenty cows; separate the cream from 1,400 l. (370 gal.) of milk; heat 1,000 l. (264 gal.) of cream; churn 200 kg. (441 lb.) of butter.

In the wine shed: Crush 10,000 kg. (11 tons) of grapes; draw from barrel 300 hectoliters (7,925 gal.) of wine and pour into other barrels; crush 170 kg. (374 lb.) of the dead wood of vines; fill and cork 250 bottles.

In the granary: Lift seventy sacks of wheat to a height of 10 m. (33 ft.); sort 100 sacks of wheat; clean with winnowing machine 10 sacks of wheat; thrash 100 kg. (220 lb.) of oats.

In the bakehouse: Knead eight sacks of flour.

For your alimentation: Produce 4 kg. (8.8 lb.) of ice; raise 3,000 l. (793 gal.) of water to 20 m. (22 yd.); sterilize 10,000 l. (2,642 gal.) of water with ozone; crush 2,000 kg. (2.2 tons) of apples for cider.

In the work shop: Saw 90 m. (98 yd.) wood; sharpen 200 sections of blades for mowing machines.

In the feed room: Cut 400 l. (45.4 pecks) of oats for horses; crush 250 kg. (551 lb.) of furze; crush 600 kg. (1,323 lb.) of oil-cake; pound 100 kg. (220 lb.) of rye; pound 300 kg. (661 lb.) of corn; pound 200 kg. (441 lb.) of wheat; cut 5,000 kg. (5½ tons) of beets; cut 500 kg. (½ ton) of straw; mix 500 kg. (½ ton) of fertilizers; grind 50 kg. (10.23 lb.) of barley.

## The Economic Value of Street Lighting

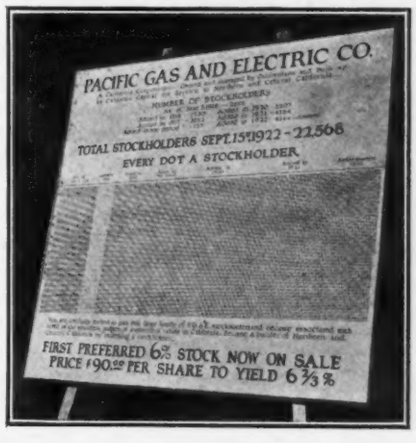
SIX HUNDRED persons are killed each year in the United States because of inadequate street lighting, says a report of the American Society for Municipal Improvements. Property damage resulting from the same cause is put at $54,000,000 a year, whereas the entire country's bill for street lighting is but $50,000,000 a year.

Urging the need for higher standards of lighting as a preventive both of accidents and of crime, the society quotes municipal statistics showing that modern street lighting has reduced crime on certain streets as much as 41 per cent, as compared with other streets in the same cities.

## Chart Showing Stockholders Stimulates Sales

BY HENRY BOSCH
Chief Draftsman Pacific Gas & Electric Company, San Francisco

TO STIMULATE its stock sales the Pacific Gas & Electric Company uses seventeen charts similar to the one shown in the accompanying illustration, which visualize graphically the actual number of


PACIFIC GAS AND ELECTRIC CO.
TOTAL STOCKHOLDERS SEPT. 15 1922 - 22,568
EVERY DOT A STOCKHOLDER
FIRST PREFERRED 6% STOCK NOW ON SALE
PRICE $90.00 PER SHARE TO YIELD 6⅔%

EVERY ONE OF 25,000 STOCKHOLDERS IS REPRESENTED BY A DOT

stockholders on the company's books. These charts measure 58 in. x 60 in. and are placed on an easel as shown. Each stockholder is represented by a colored dot $\frac{3}{16}$ in. in diameter. The annual stock sales are shown in relation to each other by using carefully selected color contrasts. Seventeen of these charts were made and placed on display in the various division offices of the company, at a cost of $35 each.

Although the advantage accruing from these charts is indirect, the attention given them by prospective stockholders has justified their existence. It is interesting to note that largely as a result of the favorable interest awakened by this display and other forms of publicity, the number of the company's stockholders increased by more than five thousand during the first five months after the appearance of these charts.

## Wiring Old Houses in St. Louis

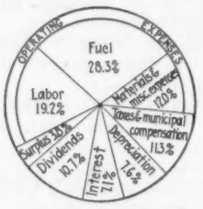
A HOUSE-WIRING campaign is being conducted by the Union Electric Light & Power Company of St. Louis which provides a financing plan whereby licensed electrical contractors may install wiring and fixtures in already-built homes and upon satisfactory completion of work may obtain payment in full from the company, which in turn will collect from the purchaser in monthly installments. The financing plan covers the new installation of wiring and fixtures or the installation of additional wiring and fixtures in already-wired homes, but does not cover installation of fixtures only.

A contractor upon developing a "prospect" sends to the Union Electric Light & Power Company an inquiry for service and credit. The company makes investigation and notifies the contractor by letter as soon as the credit of the purchaser and availability of service have been established. The contractor receives payment from the company, upon completion of wiring and installation of fixtures, after the work has been inspected and approved by the municipal authorities, by presenting a signed contract for the work together with an initial payment of at least one-twelfth of the total and a statement from the purchaser that the work has been satisfactorily completed. The campaign was started on March 12 and will continue for an indefinite period.

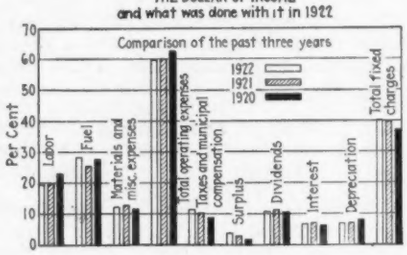
## Commonwealth Edison Year Book Analyzes Growth

FOLLOWING the policy started in 1922 of acquainting stockholders with the details of their property and also furthering customer ownership, the Commonwealth Edison Company has just issued its 1923 Year Book. It contains a carefully prepared and condensed record of the company's growth presented in terms that any reader not generally familiar with financial statements can readily understand. The explanations of the income and expense account and the balance sheet follow in the same order as the customary annual report, but under each notation is a paragraph giving the details of and reason for that particular charge.

Included in the Year Book is President Insull's address to the stockholders at the annual meeting on Feb. 26, which was broadcasted by radio to stockholders and reported in the ELECTRICAL WORLD for March 3. The book shows the growth and expansion of the company by charts and illustrations. Of particular interest is a diagram giving the proportionate expenditures of each dollar of income for operation, maintenance, interest, taxes, dividends and so forth. This diagram also gives a comparison of these expenditures for the past three years.




THE DOLLAR OF INCOME
and what was done with it in 1922




THE EDISON DOLLAR OF INCOME

The "wheel" represents the dollars received from customers during 1922. The "spokes" divide the dollar and show in percentages what was done with it. The blocks at the bottom of the chart compare the expenditures during 1922 with those of 1921 and 1920.

## What Other Companies Are Doing

**Albuquerque, N. M.**—The Albuquerque Gas & Electric Company proposes to apply for an extension of its franchise and has submitted a tentative schedule calling for a reduction in rates and increased service. It is probable that the city authorities will consider the installation of a better street-lighting system in connection with this matter.

**Chicago, Ill.**—The Utility Securities Company, which has grown out of the investment department of the Public Service Company of Northern Illinois and the Commonwealth Edison Company, is offering $250 in prizes for a better slogan than the one it is now using—"Investments that Endure." The requirements for the winning slogan are that it must not contain more than ten words and must be strong, direct, easy to grasp and easy to remember. To assist people in preparing slogans the company has issued a pamphlet listing a number of reasons why public utility securities are sound investments.

**Davenport, Iowa.**—A two-million-dollar group life insurance policy has been taken out by the United Light & Railway Company, covering its employees. Approximately two thousand employees of the company are protected by the policy, one thousand in the "Tri-Cities" and one thousand in other cities in Iowa, Illinois, Michigan, Indiana and Tennessee. The policy covers all employees in every department, irrespective of class of employment. The amount of insurance varies with the number of years each employee has been continuously in the company's service, up to ten years, after which the maximum amount, $1,500, is obtained.

**Salt Lake City, Utah.**—The good roads committee of the Salt Lake Chamber of Commerce, state, county and city officials witnessed a demonstration of a new system of highway lighting on the evening of March 23. The experimental system, consisting of fifteen highway units of 250 cp. each spread over a distance of about a mile at intervals of from 350 ft. to 400 ft., was installed at the instance of the good roads committee and the State Highway Commission. That part of the road selected for the demonstration was chosen because it presented the three most difficult problems in highway illumination, a curve, a hill and a railroad crossing. When the roadway was illuminated it was apparent that there was sufficient light at every point to make it safe to drive automobiles along the highway without headlights. The installation was made by engineers of the Utah Power & Light Company and the General Electric Company.

**Boston, Mass.**—Electric appliance sales in nine companies managed by Charles H. Tenney & Company totaled $19,698 for January, 1923, against $13,104 for January, 1922, a gain of about 50 per cent. The leading companies for the first month of this year were: Malden, Mass., $5,458; Fitchburg, Mass., $3,487; Salem, Mass., $3,027, and Montpelier, Vt., $2,995. As good an increase was marked in preliminary reports for February, 1923. For the week ended March 10 last twelve Tenney companies sold about $10,800 in appliances, of which some $8,100 were electric.

# Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

## Hydro-Electric Development and Steam Equipment

*Burning Pulverized Coal with Reduced Furnace Volumes.* — N. W. ARROWOOD.—The author argues that by thoroughly mixing coal and air in a proper burner moderate furnace volumes may be employed and excess air reduced; also, by injecting the fuel mixture into the furnace horizontally and at low velocity, temperatures will be highest at the center of the gas volume and lowest at the furnace walls. He describes the burner designed to meet these conditions.—*Power*, March 13, 1923.

*Gennevilliers Power Station.*—M. BLONDIN.—Five banks each consisting of three 60,000/3,000-volt single-phase transformers of 15,000 kva. are installed within this station. Each bank is directly connected to its 40,000-kw. turbo-generator set, with only current transformers between the two. The transformers are water-cooled. One bank of three 4,000-kva. single-phase transformers supplies the auxiliary power requirements. The oil switches used have a safe rupturing capacity of 600,000 kva. The Merz-Price selective protection system is used, protecting all feeders. To localize short-circuit currents within the internal power-supply system a number of air-core reactors are installed. These reactors are oil-cooled and are placed within tanks made of copper with a bottom and a cover of bronze. More than 125 km. of single-conductor, 60,000-volt underground cable has been laid out in concrete ducts, three cables in one duct representing one feeder. A very detailed description of this cable is given. The cable was successfully tested on the drums with 175,000 volts for one hour. Nine-petticoat porcelain bushings, cemented upon a bronze funnel, form the cable potheads, which were tested with 220,000 volts against ground.—*Revue Générale de l'Electricité*, March 3, 1923.

## Generation, Control, Switching and Protection

*Cable Protection System.*—W. PFANNKUCH.—This system, known under the name of the author, requires specially built cables with the main conductors in the center and a concentric layer of auxiliary conductors insulated from one another and from the main conductor. All of the conductors, however, transmit power according to their cross-section. At the start and the end of the cable a differentially connected combination current and potential transformer is connected to the cable, causing a slight potential difference between the main conductor and the outer conductors of the cable. As long as the cable is in perfect condition the magnetic fluxes in this special transformer resulting from the current and voltage windings will balance one another, and no current will be induced in the secondary winding. This protection system gives a warning signal for less than 1 per cent unbalance in the cable. The finding of a fault in the cable is much simplified by the aid of the insulated outer conductors and can be localized by calculation to within a few inches. The special construction of the cable increases its price about 5 per cent. The system is specially adapted to the protection of high-voltage cables and has been in successful operation for the last two years on transmission systems in Germany, Sweden, South America and Turkey, with voltages of 10,000 to 35,000.—*A.E.G. Mitteilungen*, February, 1923.

*Large-Capacity Oil Circuit Breakers. —I.*—G. BRÜHLMANN.—A large amount of valuable information on the construction and performance of oil circuit breakers can be found in this publication, dealing with the latest types of breakers up to the highest voltages. On breakers up to 500-amp. capacity no great attention need be paid to the contact surface as long as the contact pressure is high. Arcing tips are not required. Above 500 amp. well-designed brushes combined with high pressure and arcing tips must be used. Excellent insulation, avoiding dangerous creepage, is essential. In the open position only oil should be used between live and dead parts of the switch. All breakers must withstand repeated closing upon a short circuit without necessitating an inspection of the contacts. Abnormal generation of smoke may cause an arcing against the tank or between phases, against which insulating casings and partitions of heavy material are a reliable remedy. The gases developed in the oil at a violent rupture are inflammable and give, mixed with air, an explosive mixture. To avoid ignition of these gases the oil level should be high enough above the contacts to cool these gases below the flame point before they reach the oil surface. The sudden generation of these gases causes pressures of up to 8 atmospheres within the oil tank, and these pressures are usually of an oscillatory character having about 500 cycles per second. Steel boxes with very carefully made welded joints, with seams slightly beyond the edge of the tank, gave the most reliable switch tanks, rupturing at about four times the expected pressure. A contact arrangement with multiple breaks shortens the duration of the arc and lessens the danger of ignition of the gases. Congealed oil is very dangerous, because it slows down the speed of the opening and prevents the quick quenching of the arc. Using oil under pressure, as suggested repeatedly in the literature of the subject, was found in actual tests to be a decided disadvantage. With oil under 7 atmospheres pressure the arc lasted 70 per cent longer as compared with its performance under barometric pressure. At the same time, the volume of generated gases amounted to about twenty times the volume without the pressure. Excellent protection of the switch itself may be obtained with a resistor connected externally between one of the contacts and the two middle contacts (quadruple break), for which purpose a third insulated lead is usually provided on the cover of a single-phase breaker. — *Brown-Boveri Mitteilungen*, March, 1923.

## Transmission, Substations and Distribution

*Applications of Heaviside Expansion Theorem.*—LOUIS COHEN.—The author has worked out a few examples relating to somewhat different branches of electrical engineering, in order to show the wide range of application of the expansion theorem in the solution of electrical problems.—*Journal of the Franklin Institute*, March, 1923.

*Three-Phase, Four-Wire Distribution Systems.*—H. W. SMITH.—The characteristics of the three-phase, four-wire primary circuits as an ideal system of distribution are fully discussed by the author. He points out that even in very small communities this four-wire system has many advantages. Single-phase branch-feeders can be tapped from a main feeder at any point, and the improvement in regulation obtained by tying together the neutrals of two long single-phase feeders fed from a four-wire main is quite large. Small blocks of polyphase power can be supplied much more cheaply than by any other system. The necessary changes in equipment motors, transformers, etc., upon the adoption of the four-wire system are related.—*Electric Journal*, April, 1923.

## Units, Measurements and Instruments

*Derivation of Hydraulic Equation for Gage Relations and Discharges.*— D. K. C. STRATHEARN.—Methods of deriving gage relation and discharge equations employed during the recent St. Lawrence River power investigation are described.—*Canadian Engineer*, March 20, 1923.

*Current Capacity of Wires and Cables.*—G. E. LUKE.—In the December, 1919, issue of the *Electric Journal* a table giving the current capacity of conductors in still air outdoors for 40 deg. C. rise was published. Extensive tests conducted by the author and made with carefully calibrated instruments under most favorable conditions indicate that the temperatures produced by a given current are considerably higher

than indicated by the formula which was the basis of the above-mentioned table. These tests have been furthermore corroborated by entirely independent tests, which, though not extensive, check closely. The results of the author's tests are given.—*Electric Journal*, April, 1922.

## Illumination

*Ornamental Street-Lamp Installation.*—In spite of the fact that proper street lighting has been found to reduce the number of accidents, the advance in the use of new lighting units has not been so rapid as the advance in other civic improvements. This article gives data on accidents caused by inadequate illumination and on cost of street lighting and information on other important features.—*Journal of Electricity and Western Industry*, March 1, 1923.

*Car-Lighting Maintenance Methods.*—Regularity in greasing and inspection of car-lighting equipment is unquestionably one of the first requisites for its successful operation. Very good results have been accomplished on the Erie Railroad by the inauguration of a system of record keeping by means of which it becomes practically impossible for any car to be neglected without that fact being known at headquarters. Typical forms are included which include greasing and overhauling reports, inspection of axle-light equipment, battery-flushing chart, ball-bearing inspection, etc.—*Railway Electrical Engineer*, March, 1923.

## Motors and Control

*Electrification of a Large Carpet Mill.*—H. KETTON.—A detailed description is given of the complete electrification of a very large and old-established factory in which a complex series of processes contribute to the manufacture of the finished products. About 4,000 hp. of motors, together with the necessary power plant, were installed with practically no stoppage of work. A very detailed description is given of the power plant and the arrangement of the various machines.—*English Electric Journal*, Vol. 2, No. 3.

*Variable-Speed Alternating-Current Motors Without Commutators.*—F. CREEDY.—After a short general discussion, a new method of pole changing, involving the use of a number of phases greater than that in the line, is explained, together with means for simplifying the connections by the use of mutually reversed coils and by a star-mesh connection. The phase transformer needed to produce the increased number of phases is next decribed, and it is shown that the current in the windings intermediate between the three-phase tapping points is reduced to a very low value as in the rotary converter, making the apparatus small and inexpensive. The switchgear employed is discussed, and it is pointed out that the methods described render the squirrel-cage motor adaptable to almost all purposes, since they enable it to give good starting torque with low current. Machines with slip-ring characteristics are also described and test results discussed. A description is given of the cascade motor, and its unique characteristic of giving gradual adjustment between speeds is explained. Two-speed, three-speed and four-speed motors having this characteristic are referred to. Some tests of large rolling-mill and other motors are described, and finally an account is given of the application of the cascade motor as a short-circuit motor machine with slip-ring characteristics and as a unity-power-factor synchronous machine of greater simplicity and less cost than any other type.—*Journal of Institution of (British) Electrical Engineers*, March, 1923.

*Flywheels on Rolling-Mill Drives.*—F. R. BURT.—Various mill power loads and rolling characteristics which determine the advisability of flywheels for such service are discussed. In determining the size of the motor for driving a mill, both the root-mean-square or equivalent heating load and the peak load must be considered. The relative importance of heating and peak load depend roughly on what percentage of the total passes contain metal simultaneously.—*Blast Furnace and Steel Plant*, March, 1923.

## Heat Applications and Material Handling

*Scrapping Steel Cars by Means of the Carbon Arc.*—E. H. DRALLE.—The electric cutting process has proved to be an economical method of reducing scrap to sizes that can be handled and cut by shears. The work done thus far on dismantling cars by the carbon-arc process has shown that this method is decidedly superior to other methods of scrapping, and it is entirely possible that a more widespread use of this process will result in an improved means for wrecking cars which will still further decrease the already low cost of dismantling by the arc process.—*Railway Electrical Engineer*, March, 1923.

## Telegraphy, Telephony, Radio and Signals

*Wireless Antennas.*—From a consideration of the usual radiating structure it is evident that in many cases great improvement is possible, and methods by which improvement may be achieved are described. A method of calculating the various antenna constants is given.—*Wireless World and Radio Review*, Feb. 17 and March 17, 1923.

*Wind-Pressure Assumptions as Affecting the Design of Radio Towers and Masts.*—In all theory, design and specifications some assumptions are necessary, and as experience is gained the value and accuracy of these assumptions are made apparent. The ultimate weight and cost of a structure are influenced in no small degree by the initial considerations, and in the particular field under review the question of maximum wind pressures and the law connecting such pressures with height above ground level are of primary importance. The paper reviews briefly the results of past experiments and endeavors to point out what are safe and economic values of wind pressures for design purposes. The need for the standardization of wind-pressure assumptions is also brought out.—*Journal of the Institution of (British) Electrical Engineers*, March, 1923.

*The Hot-Cathode Rectifier as Applied to Radio Transmitters.*—D. G. LITTLE.—This rectifier has found a new application as a source of high-voltage direct current in connection with radio telephone and telegraph transmitting apparatus. The difficulties of a direct-current generator for voltages of 2,000 v. and above are overcome with the rectifier. Circuit diagrams and characteristic curves of this rectifier are given. The hot-cathode rectifier, using tubes of the high-vacuum electron type, offers a very convenient means of obtaining direct-current power from alternating-current supply when the current required is 5 amp. or less with voltages of 2,000 to 20,000 or even higher.—*Electric Journal*, April, 1923.

*Flat-Type Relays for Telephone Circuits.*—D. D. MILLER.—A relay for opening and closing telephone circuits is described that is flexible, reliable and economical. This relay is made up in three thousand varieties of windings and switching arrangements, but is essentially a punch-press product.—*Electrical Communication* (published quarterly by the International Western Electric Company), February, 1923.

## Miscellaneous

*Future Industrial Use of Electron Tubes.*—M. LEBLANC.—Having solved practically all mechanical difficulties in the design of electron tubes up to about 1,000 kw. output, the author foresees in a somewhat visionary article, the future uses of these tubes for industrial purposes. With the possibility of building what the writer calls an electromagnetic valve, it is theoretically easy to transform alternating current into direct current of high voltage, to transmit this current and to transform it at the end of the line back to alternating current with a satisfactory over-all efficiency. It would further be possible to use a high-frequency alternating current to transmit energy to locomotives or electrically driven automobiles without a metallic connection between the source and the vehicle. An overhead or underground condenser-trolley fed with 20,000-cycle alternating current could be devised within the field of which the vehicle, which would contain a secondary winding, would run. In this winding a high-frequency alternating current would be induced which could be transformed with the aid of electromagnetic valves into three-phase current of low frequency to energize the motor and control equipment of the vehicle.—*Bulletin de la Société Française des Electriciens*, January, 1923.

# News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

## New Telegraphic Alphabet

**System Invented by General Squier Doubles Speed of Radio, Wire and Cable Systems**

INVENTION of a new telegraphic transmitting alphabet applicable alike to radio, land lines and submarine cables was announced by Major-Gen. George O. Squier, Chief Signal Officer, U.S.A., at the annual meeting at Washington last Tuesday of the National Academy of Sciences. This alphabet, General Squier said, was more than two and a half times as fast as the international Morse alphabet now employed.

The principle upon which the new method is based is that the dots and dashes occupy equal lengths of time. No consecutive signals are of the same size, and the limit of legibility for each letter of the alphabet is practically uniform. The dots, dashes and spaces are differentiated by different intensities of the sinusoidal wave employed, in exactly the same manner that music and speech are formed. The principles of the new alphabet, General Squier said, serve to bring telegraphy into line with telephony and to base the two arts on the same fundamental principle of modulation.

General Squier claimed in his paper that this method of transmitting messages offers a plausible solution of the problem of interference and of "static" elimination and also of multiplexing a single radio-frequency channel.

## Burgess Heads Standards

**Appointed by President to the Post of Director of Bureau to Succeed Dr. Stratton**

AT THE suggestion of Secretary of Commerce Hoover, the President has appointed George K. Burgess to be director of the Bureau of Standards. Since 1913 he has been chief of the bureau's division of metallurgy. His service with the bureau dates from 1903, when he was appointed as an associate physicist. In 1905 he was promoted to be a physicist.

The appointment of Mr. Burgess follows several months of futile search on the part of Secretary Hoover for an outstanding physicist who had not been connected with the government service and who had sufficient means to allow him to make the sacrifice of income which would be entailed in the acceptance of a bureau directorship. Mr. Hoover's investigations revealed that physicists in the front rank of their profession are being paid salaries ranging from $18,000 to $20,000. He combed the country for a man possessing the requisite qualifications for this important government post, but found no one who was acceptable to him who could be induced to take the place at the salary available.

While it was Mr. Hoover's desire to bring into the bureau a man from the outside who could be expected to have ideas and plans prompted by his outside contacts, he recognized that the next best thing would be to promote some member of the bureau's staff, who would have the advantage of an intimate knowledge of its work and problems. His choice happened to fall on the ranking member of the bureau's staff, and Mr. Burgess' colleagues are unanimous in agreeing that he is best qualified to undertake the directorship.

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GEORGE K. BURGESS

Mr. Burgess was born at Newton, Mass., in 1874. He received his B. S. from the Massachusetts Institute of Technology in 1896, and he held a fellowship at that institution from 1898 to 1900. His Sc.D. was obtained in Paris in 1901. He served short terms as instructor at the University of Michigan and at the University of California. He is the author of a number of scientific articles and treatises.

Mr. Burgess has been active in the work of the National Research Council. During the war, in addition to his regular duties, he was an adviser to the requirements division of the War Industries Board and to the Ordnance Department of the army. In 1917 and 1918 he was chairman of the light alloys committee of the National Advisory Committee for Aëronautics. During the same period he was a member of the National Aircraft Standards Board.

## Smith Bills Slaughtered

**Assembly Defeats All Utility Measures by 69 to 59—Water-Power Bill Awaits Same Fate**

BY A VOTE of sixty-nine to fifty-nine on almost straight partisan lines, the Republican Assembly at Albany defeated on Wednesday the six public utility bills advocated by Governor Smith of New York. These bills had all passed the Democratic Senate. It is very unlikely that they can be brought up again this session. The New York City transit bill had been killed in the Assembly the day before. The Governor's water-power bill has not yet been brought to a vote in the Assembly, where the same fate in all probability awaits it. The six bills slaughtered Wednesday were:

The bill to create a department of public utilities for New York City, with power to own, lease, operate and control gas plants, electric plants, heating plants and telephone lines.

The bill to abolish the present Public Service Commission of five members and create in its place a commission of three, to be appointed by the Governor.

Senator Walker's so-called 5-cent fare bill, which would restore to upstate cities full power over franchise agreements with traction companies.

The bill to permit all cities to own, operate, lease and control public utilities, designed chiefly for up-state cities, so that they would have the same broad powers as were designed for New York City.

The bill to create public utility commissions in up-State cities to have control over utilities which the city might elect to own or operate, the commissions to have the same powers as the present Public Service Commission exercises.

A bill to change the wording of the Public Service Commissions law to make it conform with the proposed legislation.

## Newfoundland to Vote on Big Hydro-Electric Program

Newfoundland has been called upon, by the dissolution of its Parliament, to determine whether it wishes its vast natural resources developed by the harnessing of the unlimited power of the Humber River and the utilization of its lumber reserves for the manufacture of paper. Sir Richard Squires, leader of the Liberal party in Newfoundland, is appealing to the country for a mandate to put through a huge water-power development program with

resultant pulp and paper mills having a daily capacity of 400 tons, together with various other industrial programs. The water-power development program will be undertaken under the joint guarantee of the British government and the Newfoundland government provided that the people of Newfoundland indorse the proposal at the polls. Sir Michael Cashin, the executive head of the opposing party, is aggressively opposed to the program and has issued a circular to the electorate describing the undertaking as visionary.

The entire north and west sections of Newfoundland are strongly supporting the industrial development policy of Premier Squires, but Sir Michael Cashin is said to have a considerable following in the southeast section. The opposition is attributed to a feeling among the big fishing interests that inland industrial development will take their labor away, consequently compelling them to pay higher wages to fishermen. It is predicted that Premier Squires will be indorsed by a very large majority.

# Triumph of Superpower Seen

## Spring Convention of A. I. E. E. Discusses Technique and Policy of Electric Power Supply, Indorsing Use of Grounded Neutral and Ground Relays

ALMOST a thousand engineers from all parts of the United States and some from foreign lands listened at Pittsburgh this week to the group of splendid technical papers, filled with operating data, field experience and technical analysis of important subjects in the light and power industry, that were presented at the spring convention of the American Institute of Electrical Engineers. The papers and the discussions which followed were noteworthy for the crystallization of opinion as to the best engineering practice to be followed in lines which have been largely controversial heretofore. The use of the grounded neutral and of ground relays was accepted by power engineers and telephone engineers alike, the only difference of opinion being in regard to the use of high or low resistance, the number of multiple grounding points and similar details. It was generally accepted that no agreement on a single method applicable to all systems was likely to be reached, the individual characteristics of systems determining the exact method on each system.

### PETERSEN COIL DISCUSSED

Experience with the Petersen coil was presented, indicating its usefulness at least on low-voltage, singly-fed, single-circuit lines. More extended use of grounded relays, greater perfection in the relays themselves and the development of two new types were the outstanding points in the discussion on relays. The balanced-differential current relay had its first installation on the Duquesne Light Company's ring. The second new type was a distance time relay involving the application of a voltage coil and a current coil and the balanced-differential principle.

The electric furnace session brought out the admittedly good performance in the steel industry and the trend toward its wider application to the production of alloys. The magnetic-field effect on atomic structures in the operation of the electric furnace and its application to refining processes were suggested for investigation. More refined tests on steam locomotives indicated further advance in locomotive practice, but discussion showed that electrification still offers advantages over steam operation.

### SUPERPOWER THE BANQUET THEME

By their applause of the speakers at the banquet on Wednesday evening the seven hundred men in attendance put themselves on record as in favor of a vigorous policy of superpower development and indorsed the necessity of interstate and international networks which must be allowed to develop unfettered by the restrictions of state lines, of needlessly obstructive laws and of politics. There was an agreement that politicians must be educated by educating the public, rural as well as urban, to the benefit which will inure to it as a result of an intelligent utilization of the country's natural power resources.

Three addresses were made on this subject in addition to the remarks of President F. B. Jewett, who served as toastmaster. President Jewett dwelt on the point that all the many necessary, useful and enjoyable things that the human race has learned to do or make require power somewhere, either in operation or in construction. Therefore, as the use of these things grows and as consequently the use of power grows, there must ultimately come a time when man will have to reduce his wants because of lack of power-producing facilities unless he meanwhile develops a plan for more efficient power production and utilization. In this regard superpower development with a maximum use of water power plays a necessary part.

Paul T. Brady of the Westinghouse Electric & Manufacturing Company recalled the advance made during his lifetime in the development and use of electric power and predicted unlimited future development, but showed that interconnection was an economic necessity for adequate utilization of resources to supply the necessary power. He said in part:

"To take the next step in social progress, not only must we utilize our water-power resources to the fullest extent, but we must also use huge steam plants which will supplement the water power. The ideal location for these steam plants is beside the rivers of the coal regions, where fuel can be delivered to the boilers with a minimum of transportation and where ample supplies of condensing water can be obtained. There is a tendency on the part of certain power engineers connected with plants thus favorably located to take a short-sighted view of the power situation. 'Why should our plants co-operate with water-power plants?' they ask. 'Here we have abundant supplies of cheap fuel for generations to come. We can gain nothing by becoming part of a larger system and are therefore not interested in the project.'

"These people forget that outside the narrow limits of their own systems there are millions of people who are either paying high prices for electricity or are unable to get it at any price. They forget that their properties form an essential element in any plan to supply the country as a whole with power at the lowest cost. They forget that, if their plants become a part of such a system, they will have the widest possible market for their excess power and their surplus coal. They forget that, after all, their systems are not absolutely self-sufficient and that, unless connected with other sources of power, they may fail to give service in event of serious accidents. Finally, they forget that it is precisely this attitude of self-interest that forms one of the strongest arguments for the governmental ownership of the unified power systems. They must see the larger picture. Up north in Canada there is 18,000,000 hp. of the finest water power in the world; down here in Pennsylvania, West Virginia and Ohio there are billions of tons of coal. Employed separately, each will indeed benefit many people, but used together to the best advantage they will bring ever-increasing prosperity to all of the people in Northeastern North America.

### BETTER WORK MUST FOLLOW GOOD

"I must not be understood to be criticising our central stations. Their splendid work has alone made possible life as we know it today and has opened the way to the even fuller life that we can confidently expect the next generation to enjoy. Furthermore, no one can be censured for acting in the best interests of his own people, but good work is no excuse for not doing better work. Nothing better can be given to the people of the United States and Canada than a single international power system that will permit the utilization of our water power and coal to the best advantage and will provide every one with an abundant supply of electricity."

R. F. Schuchardt of Chicago, in discussing engineering phases of superpower, also traced the growth of power and its effect on civilization. "Cheap power has caused a rapid growth in industrial centers, and every com-

munity that has had this cheap power has prospered," he said. Virtually every European country has appointed a commission to study the means of obtaining most economically power to offset the great loss in man power, and they turned for guidance to what they term the superpower systems of America. But America is not resting on her oars, Mr. Schuchardt continued. She is going ahead to develop more power economically to relieve mankind and maintain her industrial supremacy and high standards and at the same time retain for American labor and American investment their fair share of the world's trade. Interconnection and still more interconnection is the answer, and this is at once in the interest of the industry and of the nation.

As to the engineering, it is its work to save fuel and dollars, dollars meaning labor and material. Fuel economies are understood. Dollars are saved by realizing savings due to diversity factor, a natural result of interconnection. Mr. Schuchardt issued a challenge to and yet expressed confidence in the engineer when he spoke as follows:

### Who Shall Set the Standards?

"The electricity supply industry in its onward march is bringing about many extensive interconnections. Is this development following a definite, logical engineering plan? No such plan has as yet been developed except that for the North Atlantic Coast area. What assurance have we that when the grouping of groups which is on the horizon arrives the systems will be found readily adaptable to economical interconnection? Is the frequency common and how about the voltages? Who should set up the standards and see that investments made for present extensions will have their proper value in the coming years? Who will see to it that the industry lives up to its obligation, to its trust? Naturally, the industry itself, for it is keenly alive to its obligation. Already there are committees of the industry's organization, the National Electric Light Association, studying the problem in various parts of the country, and more will undoubtedly be formed. The society of the profession most interested—that is, the American Institute of Electrical Engineers—will be an important factor in solving the problem, of course. Co-operation between all these will assure uniformity at least in the fundamentals of such studies."

M. H. Aylesworth, discussing superpower as a national policy, said in part:

"As professional engineers have good reason to know, the installation of superpower stations and systems is not hindered by questions of engineering but by weightier matters of finance, law, economics, politics and policy. These handicaps still beset us, and when they are once disposed of superpower stations will spring up with remarkable rapidity. The whole trend of economics in the electrical industry is toward larger stations and systems, and notable examples of these are to be found here in the Pittsburgh district and in numerous other sections of the country. Eventually the United States will be studded with large superpower stations, for the ultimate destiny of the country is to be covered with a network of interconnected transmission lines fed from such stations and reaching every city, town and village.

### Bulk Supply Not New

"The idea of bulk supply is not new; it is as old as the electric lighting industry itself. From the very beginning it was recognized that the economics of the situation demand that the supply of electricity for the home, for the store, for the factory and for transportation should come from one central source. Manifestly, if we are to maintain the high standard of living which is characteristic of America, the per capita earnings of the country must also be high. With the competitive markets of the world, it would be impossible to bring this about without the aid of machinery, and therefore in this country use is made of every trade facility, invention and appliance. The United States, through its great use of machinery and electricity, is able to maintain a higher standard of living than any other country because its labor produces more and earns more. During the twenty years prior to the war the annual national per capita earnings in the United States increased 116 per cent, those of Germany 52 per cent, France 27 per cent, and Great Britain 21 per cent.

"These percentages reveal much. They show what an enormous influence cheap power, which means electricity, has on the productive capacity of a nation and people, and it is chiefly because they are such great users of electricity that Americans excel in so many directions. But if we are to continue to enjoy an abundant and cheap supply of power, we must concentrate more and more in its production; we must erect fewer but larger stations; we must develop our water powers, conserve our fuel resources, and through interconnected networks of transmission lines make power available in every market. Full use of power means taking the city to the farm, giving city electrical facilities to the farmer, and this will be the salvation of this country.

### Superpower and Civilization

"Superpower is a measure of advancing civilization. It is machinery raised to the *n*th degree, superseding municipal and state boundaries and becoming national and continental in its character. It can find no abiding place in countries where life is primitive and labor cheap.

"The advance of machinery and of unified operation has had in past generations to combat two fears—the fear of the hand workman that his displacement means his destruction and the fear of the people at large that monopolies for their exploitation and oppression will spring up. The march of events in America has shown that—aside from such temporary individual hardships, regrettable, but inevitable, as every great change must bring—both fears are illusory. Nowhere else is machinery so firmly installed and nowhere else is the workman half so prosperous. Nowhere else are public service companies so large and so tied together and nowhere else are their rates and their service more firmly under the control of governmental agencies for the protection of their customers and the public at large. Superpower is a further extension of the principles of machinery and co-operation. Government regulation and customer ownership will travel with it. Cheaper energy, better service, progress, prosperity, profit and plenty will follow in its train."

Several inspection trips, including one by special train to the Westinghouse works, were scheduled for Thursday afternoon and Friday.

## Massachusetts Superpower

### Bill Signed by Governor Cox Foreshadows Union Plants at Fall River and Other Points

AN IMPORTANT step toward economic power development occurred last week in Massachusetts when Gov. Channing Cox signed a bill permitting electric light and power companies to unite in financing and building generating stations and the necessary interconnecting transmission lines and equipment. Hitherto plant developments have been by individual companies, but the new law enables the advantages of interconnection and the supply of larger areas from tidewater stations to be realized more effectively through co-operative action by utilities interested in comprehensive developments. The Department of Public Utilities will maintain its usual regulatory interest in what is done.

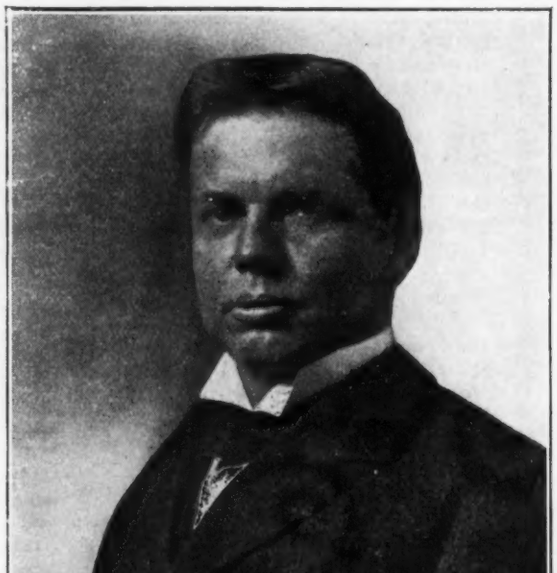
The bill was brought before the present session for the immediate purpose of financing and building a plant of 200,000 kw. ultimate capacity on Mount Hope Bay, Fall River, in the interest of the Fall River Electric Light Company, the Edison Electric Illuminating Company of Brockton, Mass., and the Blackstone Valley Gas & Electric Company of Pawtucket and Woonsocket, R. I. The general program of this development by the proposed Montaup Electric Company has been reported in a former issue of the ELECTRICAL WORLD (issue of March 17, page 648). Energy will be transmitted from Fall River to the Brockton and the Pawtucket-Woonsocket districts. The initial outlay will total about $5,500,000 and will include the generating station, a 30,000-kw. generating unit, boilers, auxiliaries and a part of the transmission lines. The first unit is to be placed in operation in 1924 and a second unit soon afterward. The design and construction of plant and lines will be handled by Stone & Webster, Inc., Boston, under whose management are the Blackstone Valley and Brockton companies.

# Schuyler S. Wheeler Dies Suddenly

## Noted Electrical Inventor, Manufacturer and Engineer Was in Full Tide of Vigor—Edison Pioneer, Builder of Ampere, N. J., and a Leading Exponent of Professional Ethics

SCHUYLER SKAATS WHEELER, electrical inventor, engineer and manufacturer, who was president of the Crocker-Wheeler Company of New York and Ampere, N. J., died suddenly of angina pectoris on Friday, April 20, at his home in New York City. Funeral services, attended by many men prominent in the electrical industry and in scientific and other circles, were held in St. Bartholomew's Church on Monday. Among the organizations represented were the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Society of Civil Engineers, the International Electrotechnical Commission, the New York Electrical Society, the Chambers of Commerce of the United States and New York State, the Electrical Manufacturers' Club and the Electric Power Club. The pallbearers included Dr. Michael I. Pupin, Charles G. Curtis, John W. Lieb, A. L. Doremus and J. J. Carty.

Many messages of sympathy and tributes to Mr. Wheeler's character, ability and accomplishments were received at his home from men of prominence in the engineering world—among them Dr. M. I. Pupin, professor of electromechanics at Columbia University; Charles G. Curtis, with whom and the late F. B. Crocker Mr. Wheeler first entered the manufacturing business; Frank B. Jewett, president of the American Institute of Electrical Engineers; Alfred D. Flinn, secretary of the United Engineering Society; John J. Carty, vice-president American Telephone & Telegraph Co., and James H. McGraw, president McGraw-Hill Company.



Schuyler S. Wheeler

Born in New York City not quite sixty-three years ago, the son of James E. and Annie Skaats Wheeler, Schuyler Skaats Wheeler came of age at the very time when electric light was emerging from the laboratories of the inventors to illuminate the streets and buildings of cities and villages. He left Columbia College in 1881 and obtained the post of assistant electrician in the American branch of the Jablochkoff Electric Light Company, subsequently transferring his services to the United States Electric Light Company, at that time coming into the field with the direct-current arc lamp, and then, with an unfailing sense of the lines along which electrical progress would be made, seeking and obtaining a place on the staff of Thomas A. Edison. Young Wheeler was one of the historic group present at the opening of the Pearl Street central station in New York City forty-one years ago. He superintended the installation of a number of the distribution systems that followed this pioneer—notably the underground systems at Fall River, Mass., and Newburgh, N. Y., and was in charge of operation in the latter city.

The field of invention and manufacturing soon, however, came to have a greater appeal to the young electrical engineer than that of installing and operating plants, and in 1886, after acting as electrician for the Herzog Teleseme Company, to which he contributed important inventions, he became connected with the C. & C. Electric Motor Company, just organized by two friends of his, Charles G. Curtis, of Curtis turbine fame, and the late Francis B. Croker, whose name and Wheeler's became permanently associated and who died two years ago. The C. & C. company manufactured small electric motors—a novelty at that time—and, under Dr. Wheeler's guidance as designer, electrician and factory manager, the company grew rapidly. In 1887 and 1888, however, Crocker and Wheeler severed their connection with it and founded the Crocker-Wheeler Company, of which Dr. Wheeler was president from 1889—when Mr. Crocker was appointed to the newly established chair of electrical engineering at Columbia University—to the time of his death. This company at once assumed and has always maintained a foremost position in the manufacture of motors.

From 1888 until 1895 Dr. Wheeler, in addition to his private business, acted as electrical expert of the Board of Electrical Control for New York, during which time the task fell to him of seeing that all overhead lines were placed under ground. He carried out this duty faithfully and energetically and did not hesitate to remove poles by force when other means failed. In the year last named he resigned his municipal duties to devote his whole time to his manufacturing enterprise.

It was in 1895 that the works of the company, which a few years after its organization had been moved to the new town of Ampere, near East Orange, N. J.—a town that owes its existence and its name to the Crocker-Wheeler Company—were completely destroyed by fire. Almost before the ashes had cooled a larger and ultra-modern plant began to rise on the same site, while the business of manufacture went on in tents and sheds with electrically driven tools. The company was able to fill most of its orders, its business continued to increase by leaps and bounds, and the disaster was changed into an ultimate blessing.

The Latimer Clark library, the largest collection in existence of electrical books, was purchased by Dr. Wheeler in 1900 and presented to the American Institute of Electrical Engineers. This splendid collection contains every publication in the English language on the subject of electricity printed prior to 1886, including the rare sixteenth and seventeenth century works. It forms a literary monument alike to Dr. Wheeler's love of learning and his public spirit. He served as president of the Institute in 1905-06 and was at the time of his death chairman of the committee on code of principles of professional conduct, a subject that appealed to him so strongly that he had made it the theme of his inaugural presidential address, in which he expounded the duty of the engineer to his client, to the public and to his professional society.

Dr. Wheeler is said to have himself designed more than a thousand electric drives, including those for the complete equipment of the Government Printing Office and the Bureau of Engraving and Printing at Washington and other government plants. His activities and sympathies were not, however, limited to his great manufacturing enterprise. Besides the A. I. E. E., he was a member of the American Society of Civil Engineers and the American Society of Mechanical Engineers and was one of

the founders of the United Engineering Society. As recently as last November he served as one of the American representatives at the meeting of the International Electrotechnical Commission held at Geneva, Switzerland, and while in Europe he visited a number of countries, attending meetings of those interested in electrical manufacturing problems and investigating post-war conditions as they affected the electrical industry.

One side of his nature was shown by his institution at Ampere of a workroom devoted to teaching blind men and women to wind armature coils with tape. During the war this enterprise was carried on with special reference to soldiers who had lost their sight, and some of these were trained to be themselves teachers of others.

He contributed articles on technical subjects to various magazines and engineering journals, and his book on the "Practical Management of Dynamos and Motors," written in his earlier years conjointly with Professor Crocker, went through a number of editions and attained a large circulation.

### As Organizer and Executive

Perhaps a better estimate of Dr. Wheeler's abilities and the personal characteristics on which was built his great success as an engineer-manufacturer could not be given than that made many years ago, but as relevant today as ever, by Gano S. Dunn, then chief engineer of the Crocker-Wheeler Company, now president of the J. G. White Engineering Corporation. Mr. Dunn said:

"While Dr. Wheeler possesses the true engineering mind, that broad judgment which seems to rise above calculations and intuitively determine the salient principles of an engineering problem, and while it is to this characteristic, producing valuable inventions and designs, that his early successes were due, it is not in this direction that he has done his latest and best work. It is as an organizer and an executive, as an inventor of new methods of factory operation, to win success out of latter-day competition, that he has been pre-eminently successful and has blazed a way into a comparatively new country of manufacturing economics. Industrial organization in this country is carrying the lamp of progress far ahead into the darkness of old-fashioned and inadequate methods, and to such progress Dr. Wheeler is one of the men who have made great contributions."

Describing in some slight detail how meticulously every item of material and every finished part was followed through the factory by ledger entries, and how the writing of specifications, the issuing of orders and requisitions and the reporting of receipts and deliveries were checked at every step by a system that worked almost automatically, Mr. Dunn said:

"The result of such provisions for dealing with the minute as well as with the greater elements of manufacture has proved to be a greatly increased output, a diminished cost of production, a minimum of capital locked up in inactive stock, shutdowns for inventories no longer a necessity, and a promptness and certainty of delivery that attract business. The mob, organized into files, ranks, corporals, sergeants, captains, becomes an army, mobile and efficient. Many others have contributed to the higher industrial organization here referred to, but Dr. Wheeler has led in carrying it to some of its most successful developments."

He was a member of the Chamber of Commerce of New York and of the American Association for the Advancement of Science, as well as of a number of social and country clubs. He was also a director of the City Trust Company of Newark and of the Helicopter Company, Inc. Of the latter he was secretary.

In 1904 Dr. Wheeler received the John Scott medal of the Franklin Institute for the invention of the electric buzz fan. The degree of doctor of science was conferred on him by Hobart University, Geneva, N. Y., in 1894. Besides his New York residence, he maintained a home at Bernardsville, N. J.

## Cut in Commercial Lighting Rates of Detroit Edison

A reduction in the commercial lighting rates of the Detroit Edison Company has been directed by the Michigan Public Utilities Commission, this cut taking place in the second rate block and bringing a rate of 4 cents a kilowatt-hour in that block instead of 5 cents as formerly. This restores the pre-war rate.

Alex Dow, president of the company, in commenting on the order said: "The proposed reduction of commercial rates is in accordance with the arrangement arrived at a year ago with the Public Utilities Commission. At that time the question arose whether available earnings should be applied to reduce the rate for residential service, or the rate for commercial service, or should be split between the two, and it was the opinion of the commission, and ordered by it, that the reduction should be made in the rate for residential service as the place where it would do most good to the ultimate consumer, with the understanding that as soon as continuing improvement of business warranted further reduction would be given to the commercial consumer. This present reduction carries out that understanding. It is warranted by the present and expected earnings of this fiscal year.

"General business conditions in Detroit are very good," Mr. Dow went on, "and the demand for new connections and industrial power is likely to run over available capacity during the fall of the year. The output from the company's plants for the first three months of this year was 339,000,000 kw.-hr. as compared with 242,000,000 kw.-hr. for the similar period last year."

## Southern Power to Go Slow

**Soaring Construction Prices May Cause Postponement of Contemplated New Development**

REPORTS from North Carolina indicate that increasing building costs are proving a serious bar to the construction program which the Southern Power Company had planned for this and succeeding years, and that because of these increased prices the program may be indefinitely delayed. While no Southern Power Company official is willing to be quoted to this effect at this time, there is thought to be no doubt of the correctness of the statement. The company finds that rates as they now are and construction costs as they now are eliminate any possibility of a dividend from new construction, and without dividends reasonably in sight it cannot secure money for building.

As readers of the ELECTRICAL WORLD have been informed, the company now has under construction two great hydroelectric plants, one at Mountain Island, near Mount Holly, N. C., to develop 80,000 hp., and one at Great Falls, S. C., to develop 60,000 hp. The Great Falls plant, where it was only necessary to build a power house, the company already having a dam, will soon be completed, and the Mountain Island plant will be completed during the present year. In addition the company is building two 10,000-hp. auxiliary steam plants, one at Mount Holly and one at Eno. About two hundred miles of transmission lines and the necessary substation equipment are also being built. The power demand is now away ahead of the supply which the company is able to furnish, and while it is true that the company will soon have an additional 100,000 hp., that was all contracted for many months ago.

### Construction Prices Soar

The company's engineers have for months been figuring on possible sites for new development, the effort being to find where the most power could be developed for the least money. The engineers finally settled on a 50,000-hp. site on the Catawba near Rhodhiss. It has developed during the last few days, however, that at present costs of labor, material and hydraulic and electrical equipment it may be impossible to develop even this site because the income from the power that would be produced would not take care of the investment. Engineers and construction men have recently declared that the contracts for the Mountain Island plant and the Dearborn plant at Great Falls, let about Dec. 1, 1922, were at figures about 25 per cent or more under the present level of prices.

The public has been keenly interested in the prospective further development of the Southern Power Company, not only because of the large investment directly entailed but because of its far-reaching effects on the industrial development of the Carolinas.

## Electrical Men Speak

**Britton and Ballard Address Pacific Coast Meeting of A. S. M. E. on Utility Questions**

JOHN A. BRITTON, first vice-president and general manager of the Pacific Gas & Electric Company, acting as toastmaster at the banquet of the first Pacific Coast regional convention of the American Society of Mechanical Engineers in Los Angeles on the evening of April 18, struck the keynote of the sessions when he urged upon his hearers the necessity of their becoming more familiar with questions of public policy affecting present-day utilities. The proper and delicate handling of these matters, he said, made the continued services of the mechanical engineering profession profitable to its members and useful in the upbuilding of the nation.

J. L. Harrington, president of the A. S. M. E., alluded to the fact that a century ago 90 per cent of the population of America followed agricultural pursuits, while today only 30 per cent of our population is so engaged. He urged the engineer to contribute in larger part to the running of government. Ira N. Hollis, past-president of the society, alluded to the necessity of solidarity in engineering effort. H. M. Robinson, president of the First National Bank of Los Angeles, declared that within the next three years San Francisco and Los Angeles will see in full production the local manufacture of pig iron and steel.

### How One-Tenth Cent May Mean Much

R. H. Ballard, vice-president and general manager of the Southern California Edison Company, impressed upon his audience the fact that in those sections of America where strong, prosperous public utilities prevail the most prosperous communities are to be found. He showed how delicately the whole fabric of utility prosperity is interwoven with slight changes of rates when he brought out that in California a difference of one-tenth of a cent per kilowatt-hour would make a difference of 5 per cent in the surplus of earnings and thus assure the continued prosperity of a utility.

William Mulholland, chief engineer of the Los Angeles Bureau of Light and Power, paid a tribute to the genius of the engineer. Robert Sibley, Pacific Coast consultant for the McGraw-Hill Company and vice-president of the A. S. M. E., in speaking of the industrial and electrical West, pointed to the necessity of breaking the deadlock in the proposed development of the Colorado caused by the failure of the Arizona Legislature to approve the interstate compact and urged that pressure be brought to bear to get action, to the end that the present generation might receive some of the benefits that must accrue from this great storehouse of hydro-electric energy.

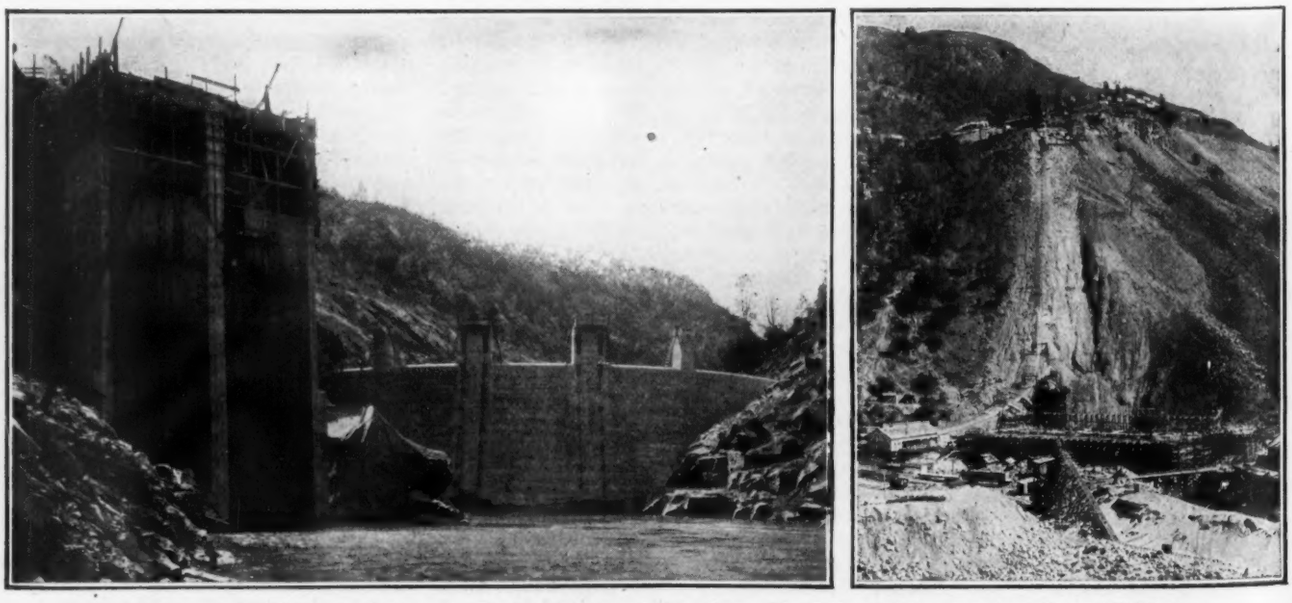
There were about two hundred engineers in attendance at the three-day sessions, many of them being from Eastern manufacturing centers and making their first visit to the West.

## Fourth Plant on Big Creek Started

**Southern California Edison Company Begins Work on the Superstructure of Power House—Eventual Rating to Be 210,000 Hp.—Operation in the Fall Expected**

WORK on the superstructure of the fourth power house on the Southern California Edison Company's Big Creek project, known as Big Creek plant No. 3, which will have a larger generating capacity than any other hydro-electric plant in the West, was started by the company on April 12. The completion of this plant will be the consummation of the fourth step in the Edison company's Big Creek project, which contemplates the development of 1,400,000 hp. from the watercourses of the high Sierra Mountains in central California, at a cost of $375,000,000. The company's budget for 1923 is $26,000,000, which includes, besides the work on the Big Creek project, large expenditures for transmission lines, distribution lines, substations and other construction. More than four thousand men are now engaged on the various phases of the Big Creek project.

The initial installation in this new plant will consist of three 35,000-hp. units, which is one-half of its ultimate development. These will be vertical turbines, built by the Wellman-Seaver-Morgan Company, operating at a speed of 423 r.p.m. and under a head of 760 ft. The generators, which are being built by the Westinghouse Electric & Manufacturing Company, will be rated at 25,000 kva., 11,000 volts, 50 cycles, and will have direct-connected exciters. The building will be 200 ft. long, 139 ft. wide and 110 ft. high from the tailrace floor to the roof and will be of reinforced concrete and structural steel. A feature of the design of the building is the elimination of the basement in the generator room. As the plant is laid out, the operating floor will be on two levels, one at the base of the generators and the other at the elevation of the turbines, so that virtually all of the equipment will be in view of the operator at all times. The switching station will be 195 ft. wide and 430 ft. long and will consist of a series of concrete benches placed on the slope of the mountain, there being a difference in elevation of 46 ft. between the upper and lower benches. These benches will support the 220,000-volt transformers, oil switches and bus.



CONSTRUCTION WORK ON CALIFORNIA EDISON COMPANY'S BIG CREEK NO. 3 PLANT WILL REQUIRE ONLY 141 DAYS

Water will be diverted from the San Joaquin River at a point 6 miles above the power house and just below the tailrace of Big Creek plant No. 8, and conveyed through a 6-mile tunnel having a bore of 21 ft. The tunnel, excavated from solid granite, will be unlined throughout except for one or two places where bad ground was encountered. It will have a capacity of 3,000 second-feet. The excavation is being done by air-operated steam shovels adapted to work in a 21-ft. bore. The muck is being removed by combination trolley and storage-battery type locomotives. Work on this tunnel is now nearly completed.

The penstocks will be made entirely o lap-welded pipe, varying in diameter from 7½ ft. to 6 ft. The valves at the bottom will be of the needle type, and those at the upper ends of the penstocks will be butterfly valves controlled from the power house. At the upper end of the penstocks a surge tank excavated from solid rock will be installed. It will have a shape similar to an hourglass, the largest portion being about 75 ft. in diameter.

The first generating unit in the new plant will be placed in operation about Aug. 1 and will be followed by the second unit about Sept. 1, and it is expected that the entire plant will be completed and the power placed on the lines about Oct. 1 of this year. The power will be transmitted a distance of 240 miles over the first commercially operated 220,000-volt transmission line in the world.

Construction work is now under way on the 13-mile tunnel connecting Lake Florence and Lake Huntington, and with the completion of this tunnel the great watersheds of the High Sierras, having an area about the size of the Hawaiian Islands, will be tapped and the water utilized for an ultimate development of 1,400,000 hp., with a total head of more than two miles.

## Innocent New York Officials Ask About Superpower

The Water Power Commission of the State of New York apparently is not familiar with the superpower survey of the Boston-Washington area made by the United States Geological Survey. Recently the Governor of New York was asked by the Federated American Engineering Societies if his power-development policies would conflict with the superpower plan. Governor Smith referred the letter to the Water Power Commission, which, in replying, said: "Inasmuch as you have not stated how your so-called 'superpower system' is to be carried out and its sources of power, it is impossible to say whether same would be in conflict with the Governor's policies. Would be pleased to have you advise us more fully of the real plan of the superpower system."

With regard to Governor Smith's ideas as to the handling of power development, the letter reads:

"The policy of the Governor relative to power development in behalf of the State of New York is well known in this state. His message to the Legislature declares in effect that the undeveloped water power on the Niagara and St. Lawrence should be developed by the state, that the base power available therefrom should be transmitted to the various municipalities over lines state-owned and controlled, that the electricity so generated be sold to the municipalities at approximately the cost of production and delivery, that the final distribution to the ultimate consumer be made through the agency of the municipality, through existing companies, or by the municipalities, subject to the approval of a state hydro-electric commission as to rates and service."

## Electrical Men Competing in Electrified Homes

Members of the New York Electrical League held a voting contest at a regular meeting on Tuesday of this week to determine which one of them lives in the most completely electrified home. The purpose of the contest was to develop a wider interest locally in the idea that electrical men themselves should lead the community in the completeness with which their homes are wired and the number of appliances which they use.

A special schedule crediting an appropriate number of points to various classes of wiring outlets and to all types of household appliances has been developed as a basis for such contests in the interests of the so-called "Electrify Club," which has been promoted by R. S. Hale, chairman of the N. E. L. A. wiring committee. Copies of this schedule were mailed to all members of the New York Electrical League in advance, and all members and guests at the meeting were invited to make reports on their home equipment and compete for the several prizes offered.

An electric coffee urn, with cream jug, sugar bowl and tray, was contributed by the Edison Electric Appliance Company; *Electrical Merchandising* offered an electric waffle iron, the Illuminating Glassware Guild a portable lamp, the General Electric Company an electric fan, the Simplex Electric Heating Company and the Western Electric Company electric flatirons, and the Westinghouse Electric & Manufacturing Company a tumbler immersion heater.

The highest score turned in was that of Clarence Law of the New York Edison Company, with 227 points. F. S. Montgomery of Wynkoop, Hallenbeck & Company followed with 216 points. A. Lincoln Bush, president of the New York Electrical Contractors' Association, was third with 195 points. Walter Neumuller, New York Edison Company, had 193 points; H. M. Walter, electrical contractor-dealer, 172 points; Roger Williams, Simplex Electric Heating Company, 157 points; F. S. Hartman, General Electric Company 146 points, and Albert Goldman, New York Edison Company, 145 points.

## "Tri-State" Changes Name

### Four Other Commonwealths Join It and Make Up the Southeastern Water and Light Association

AT THE annual convention of the Tri-State Water and Light Association, held in Birmingham, April 17, 18 and 19, the name of the association was changed to the Southeastern Water and Light Association, and Alabama, Tennessee, Mississippi and Florida were added to the constituent states, which formerly included only Georgia and North and South Carolina.

The convention was given over largely to waterworks and piping, but on Tuesday E. T. Austin, General Electric Company, Atlanta, discussed the development of street lighting, and on Wednesday L. V. Gaffney of the Gaffney (S. C.) electric plant spoke on "Increasing the Day Load." On Thursday the delegates made a visit to the plant of the Alabama Power Company at Lock 12 and to Mitchell Dam, under construction on the Coosa River. Other visits were made to manufacturing plants in Birmingham. Following a banquet Thursday night at the Tutwiler Hotel, "The Power Factor: What It Means to the Central Station," was one among other subjects discussed by the delegates.

#### OFFICERS ELECTED

J. E. Gibson of Charleston, S. C., was re-elected for the third term as president. The following were elected as vice-presidents: D. L. Caston, Gainesville, Ga.; E. M. Foster, Greenville, Miss.; R. O. Polglaze, Gadsden, Ala.; I. S. Robinson, Columbia, Tenn.; Frank Schnabel, Clearwater, Fla., and C. L. Korner, Charlotte, N. C. W. F. Stieglitz of Columbia, S. C., was elected secretary and treasurer for the ninth consecutive time.

The selection of the place for holding the next convention was left to the executive committee. More than one hundred engineers, publicity utility managers and makers of machinery attended.

## Date for Iron and Steel Exposition Set

Sept. 24 to Sept. 28 has been selected as the time for the Iron and Steel Exposition to be held under the auspices of the Association of Iron and Steel Electrical Engineers in the Broadway Auditorium, Buffalo. This building will seat twelve thousand people. The main exhibition floor has 50,000 sq.ft., which will be devoted exclusively to display of apparatus used in the iron and steel industry, and this space is rapidly being reserved by the manufacturers who supply the millions of dollars' worth of steel-mill equipment purchased each year. More than three thousand industrial establishments alone in the vicinity of Buffalo will co-operate in making the exposition a highly specialized form of education.

## Promptness the Keynote

**N. E. L. A. Plans to "Pull Off" Its June Convention at New York City Right on Schedule**

PROMPTNESS is to be an outstanding characteristic of the forty-sixth convention of the National Electric Light Association, to be held in New York City at the Hotel Commodore during the five-day period from Monday, June 4, to Friday, June 8, inclusive, and the hours given in the following paragraphs mean "sharp" time, according to the "General Convention Circular" just issued from headquarters.

The general and executive sessions will be held on the mornings of Tuesday, Wednesday, Thursday and Friday, 9.30 a.m., adjourning about 1 p.m. These four sessions will be held in the main ballroom of the hotel. There will be no meetings held in parallel with them.

The public policy committee session will be held on Thursday at 9 p.m. in Carnegie Hall, Seventh Avenue and Fifty-seventh Street. It is planned to broadcast this session by radio.

The customer-ownership committee session will be held on Thursday at 2:15 p.m., at the Hotel Commodore.

The Accounting National Section sessions will be held on Monday, Tuesday, Wednesday and Thursday at 2.15 p.m., adjourning about 5.30 p.m. All four sessions will be held in the music room, Hotel Biltmore, immediately adjacent to the Hotel Commodore.

The Commercial National Section sessions will be held on Monday, Tuesday, Wednesday and Thursday at 2.15 p.m., adjourning about 5.30 p.m. All four sessions will be held at the Hotel Commodore.

The Public Relations National Section sessions will be held on Monday, Tuesday and Wednesday at 2.15 p.m., adjourning about 5.30 p.m. All three sessions of this section will be held at the Hotel Commodore.

The Technical National Section sessions will be held on Monday, Tuesday, Wednesday and Thursday at 2.15 p.m., adjourning about 5.30 p.m. All four sessions will be held at the Hotel Commodore.

The president's reception will take place on Monday evening at the Hotel Commodore. There will be entertainment on Tuesday and Wednesday evenings. Automobile and sight-seeing trips and other forms of diversion will be provided for the ladies attending the convention.

All delegates who have not engaged transportation and made their hotel reservations should do so at once.

## Commonwealth Edison Orders 60,000-Kw. Generator

For its new Crawford Avenue power house the Commonwealth Edison Company of Chicago has just placed with the General Electric Company an order for a 60,000-kw. cross-compound steam-turbine generating unit, the largest generator ever purchased by the Chicago company and equal in rating to any yet manufactured. This is the third generating unit ordered by the Commonwealth Edison Company for its Crawford Avenue station. As previously reported by the ELECTRICAL WORLD, it has an order from C. A. Parsons & Company of England a 40,000-kw. unit and from the Westinghouse Electric & Manufacturing Company one of 50,000 kw. rating. The Crawford Avenue station is to have an ultimate capacity of from 400,000 kw. to 600,000 kw.

## No Action Taken on Colorado Projects

**Following Decision of Cabinet, Federal Power Commission Refuses to Issue License for Diamond Creek Now—Arizona Resents Coercion from Washington**

DISCUSSION of the Girand project at Diamond Creek on the Colorado River at the Cabinet meeting on April 20 resulted in a decision that no action should be taken at this time on the application for a license. This led the Federal Power Commission, at a meeting on April 23, to deny the plea of Mr. Girand for immediate action. It had been pointed out to the Cabinet officers composing the Federal Power Commission by the members of the commission's staff that all provisions in the Colorado River compact could be made conditions in any license issued for the Diamond Creek development. The action was taken with full knowledge that the Arizona Legislature while in session had telegraphed the commission protesting vigorously against withholding action on the Girand application and stating that any such action on the part of the Federal Power Commission would be regarded as an intolerable effort to coerce a sovereign state.

### GIRAND PROJECT GOES OVER

The Federal Power Commission first took up the discussion of its Colorado River policy at a meeting on April 19. At that meeting L. Ward Bannister, an attorney representng the Governor of Colorado, told the commission that Colorado is radically opposed to the granting of the Girand license until the Colorado River compact shall have been ratified. He expressed Colorado's opposition to any more interstate litigation and declared that the doctrine of an equitable division of water on which the compact was based is much sounder than the doctrine of prior appropriation of water. Senator Kendrick of Wyoming told the Commission that more money had been spent in lawyers' fees than in project works and urged that no chance be taken in granting the Girand license. Senator Cameron of Arizona, strangely enough, also opposed the Girand project on the ground that Arizona would be more greatly benefited by the Stetson project, providing for a 1,200-ft. dam at Boulder Canyon, which would flood out completely the proposed Diamond Creek dam.

Members of the Federal Power Commission's staff made it very clear that in their opinion the only valid argument against granting the Girand license is that the delay holds a club over Arizona. They do not share the optimistic opinion expressed in some quarters that a special session of the Arizona Legislature will be called and the compact ratified promptly. Fear is expressed, on the contrary, that the probability of another long delay will be very discouraging to the financial interests which were prepared to pour nearly $100,000,000 into the Diamond Creek development.

## Abilene (Tex.) Has Model Ice and Electric Plant

A new ice and electric plant at Abilene, Tex., built along model lines to replace one destroyed by fire in the spring of 1919, has recently been put into operation by the Abilene Gas & Electric Company. The electric station serves Abilene and twenty-seven other communities by a system of high-tension transmission lines extending in four directions over a territory of 286 square miles. The company has 8,600 customers, and the connected load is 10,000 kw., about equally divided between lighting and power. The territory served is building up rapidly, and work on an extension to three more towns has been begun.

The building is of reinforced-concrete and hollow-tile construction. The generating equipment consists of two units, the first being a Westinghouse 2,500-kva. turbine-generator with a direct-connected exciter and the second a General Electric 1,250-kva. turbine alternator with the exciter independent and motor-driven. As a reserve unit a steam-driven General Electric exciter is provided. Energy is generated at 4,150 volts and is distributed through eight feeder circuits. From a 33,000-volt switching structure, provided with remote-control oil circuit breakers and metering equipment, transmission lines extend north, east, south and west. The switchboard was built by the Westinghouse company.

The boiler plant consists of three 414-hp. Stirling boilers, two of which are arranged in one battery with the third forming a half battery but so arranged that the installation of another boiler will complete it. These boilers are equipped with Babcock & Wilcox superheaters for 150 deg. of superheat, and the plant carries a steam pressure of 200 lb. The boilers are equipped with Duquesne burners of the combination oil and gas type. Water is obtained either from the city's supply or by gravity from a lake which is located near by.

In the engine room there are two York ammonia compressors of 75-ton and 40-ton capacity. To each of the machines is connected a York uniflow steam engine which operates condensing. The condensing equipment is a 1,000-sq.ft. condenser, with motor-driven air and condensate pump and motor-driven circulating water and booster pumps. A natural-draft cooling tower with spray nozzles in the upper section is provided. Water for ice making is taken from the condensate of the ice-machine engines and the turbines of the electric plant and is boiled in a vacuum-type reboiler.

## Brief News Notes

**Progress in Guatemala City.**—A contract recently signed on behalf of the government of Guatemala gives authority to concessionaires to acquire hydro-electric rights and distribute light, heat and power in the capital city for a period of thirty-five years, U. S. Consul A. C. Frost reports. An electric belt-line street-car system will replace the present mule-drawn cars.

**Oskaloosa Will Not Build Municipal Plant.**—Rates for electrical energy for both light and power will drop 40 per cent in Oskaloosa, Iowa, as the result of the action of the City Council in accepting an offer made by the McKinley interests, owners of the Oskaloosa Traction & Light Company. Because of this reduction of rates the city will not build the municipal plant for which a bond issue of $370,000 was recently voted.

**Albuquerque Utility Gets Long-Term Franchise.**—By a close vote the City Commissioners of Albuquerque, N. M., have granted to the Albuquerque Gas & Electric Company a twenty-five-year extension of its present franchise, the company having agreed to make a reduction to all users amounting to 1 cent a kilowatt-hour on the residential rate and ½ cent on the power rate. The company has 4,985 consumers of energy on its books.

**Electric Truck Show in N. E. L. A. Convention Week.**—The annual New York electric truck show, to be held during the week of June 4 in the Irving Place showroom of the New York Edison Company, will include exhibits by all the manufacturers represented in the metropolitan territory. This is the week of the annual convention of the National Electric Light Association, which will devote a session to discussing the electric truck.

**Carnegie Summer Courses.**—Courses to interest nearly any one in need of technical training will be given this summer at Carnegie Institute of Technology, at Pittsburgh, according to a preliminary announcement. Of special interest to electrical students are the courses offered in the College of Industries, which will include elementary electric wiring, advanced electric wiring, elementary principles of electricity and direct-current machinery.

**Electricity from Nature's Steam.**—The development of electric power from steam generated in the earth by nature will be a reality in the near future if the Geysers Development Company is successful in its efforts to harness the steam. One well has been bored and capped and, according to estimates of engineers, there is sufficient steam to generate 2,000 hp. of electricity. About $35,000 has been subscribed by residents of Healdsburg, Cal., a town near the geysers. In Italy steam from the earth has been successfully used for generating electricity for some years.

**Quebec Fights Speculation in Water-Power Sites.**—Quebec is determined, reports from that province indicate, to put an end to the withholding from development for speculative reasons of the province's water-power resources. Honoré Mercier, the Minister of Lands and Forests, is urging that leases shall contain specific requirements as to the program of development. In this he has the backing, it is declared, of a strong public opinion which is opposed to the retention of natural resources by those who are not disposed to develop them. It is estimated officially that Quebec has 6,915,244 hp. of primary hydraulic power and 11,640,052 hp. of power which could be utilized for at least six months of the year.

**Radio Medical Service for Seamen.**—A year ago the United States Public Health Service announced that it had completed arrangements to expand the medical aid service to American seamen with which it had first been charged by Congress a century and a quarter ago by prescribing by radio for any sailor who might be taken ill at sea and who might apply. Messages for aid were to be forwarded to the service by the ship's radio. It is now reported that the range of diseases and mishaps for which aid has been invoked during the first year has been amazing, extending from appendicitis to hiccoughs and the swallowing of broken glass. The Public Health Service physicians at hospitals ashore prescribe treatment by radio with the knowledge that the drugs they specify are probably in stock on the vessel.

**New York Edison Lectures on Trucks Score Big Success.**—The course of lectures for electric truck owners, operators and garage attendants held under the auspices of the New York Edison Company, which came to an end on April 12, proved so successful that plans are already under way for its repetition next year. It was said to be the first attempt that had ever been made to give a systematic course of instruction in the principles of the electric truck, and those enrolled, representing many New York business houses, included both employer and employee. When the course was planned and a fee of a dollar was announced, it was hoped that at least twenty-five and possibly forty could be enrolled. But the enrollment exceeded three hundred in spite of every effort to hold it down. Some of the classes were so large that the lectures had to be repeated.

**Monticello, Ind., Has Largest Hydro-Electric Plant in State.**—Negotiations for the sale of the electric plants at Monon, Francesville and Medaryville, Ind., owned by the Continental Utilities Company of Michigan, to the Interstate Public Service Company for $90,000 have been completed. The Interstate company has been supplying these distribution plants with power from the hydro-electric power plant constructed at Monticello by the Indiana Hydro-Electric Company, which the Interstate Company operates. The new Monticello plant is the largest hydro-electric development in Indiana. It will provide 10,000 hp. daily for light and power, serving at least twenty-five cities and towns in the northern part of the state. The Interstate company is completing a transmission line from Monticello to Logansport, connecting with the Indiana Service Corporation, and it already has a line connecting near Kentland with the Central Illinois Utilities Company, carrying power into Illinois.

**Federal Government Asked to Start Safety Program.**—The United States government sanctions working conditions that would not be tolerated by private employers, it is declared by the Federated American Engineering Societies, which appeal for a federal safety program. Congress is asked to enact safety legislation providing for the safe construction and equipment of buildings, regular inspection of conditions and the training of employees to observe proper precautions against accident. "The government should in its industrial plants set an example to private employers by providing for its own employees working conditions which are safe, hygienic and sanitary," says the statement issued by the federation and prepared by Morton G. Lloyd. The federation also recommends the adoption by the several states of uniform legislation aiming at the creation of administrative officials who shall have power to make and to enforce regulations for the prevention of accidents and industrial diseases.

**Electric Drive in the Golden Gate.**—Three electrically driven vessels recently received trial trips at San Francisco. Two of these were ferryboats and the other was an oil tanker. The latter is the first electrically driven tanker ever constructed. Its equipment includes two 750-hp. Pacific Diesel engines, two General Electric marine-type generators and two General Electric marine-type motors connected to the same propeller shaft. The ferryboat Hayward was built for the San Francisco-Oakland Terminal Railways and will be used in the passenger service on San Francisco Bay. The propelling equipment consists of a Curtis turbo-generator set, rated at 1,100 kw., with direct-connected exciter. Each of the two propellers is driven by a 1,200-hp. General Electric marine-type motor. The ferryboat Golden West is a sister ship to the Golden Gate, which has

been in operation on San Francisco Bay for some time. It is driven by two Pacific Diesel engines with General Electric generators and two marine-type General Electric motors, one on each propeller.

**Survey of Colorado River to Go On.**—The deep and narrow gorges of the Marble and Grand Canyons, said to be the most treacherous in the world, will be surveyed by a party of engineers and geologists of the Department of the Interior this summer, when a complete group of maps will be made of the Colorado River for a distance of 300 miles from Lee's Ferry to Grand Wash, Ariz. A program of special stream surveys, showing the plan and profile of streams with sufficient topography to cover all possible locations for structures needed in a comprehensive scheme of water development, was initiated in the Colorado River basin in 1909. An aggregate of about 1,200 miles on Colorado and Green Rivers and several hundred miles on principal tributaries had been mapped by the end of 1922. There are now available, with the exception of the stretch of about 300 miles to be surveyed this year, maps of a continuous river survey from the town of Green River, Wyo., on the Green River, and from Grand Junction, Col., on the Colorado River, to the Mexican boundary. This year's exploration party will consist of ten men, including two topographic engineers, one hydraulic engineer and one geologist. Detailed examinations of possible dam sites, both from an engineering and a geological point of view, will be made.

**Salt Lake Holds Electrical Convention.**—At the second annual convention of the electrical interests of Salt Lake City and the adjacent territory, held on April 6 at the Hotel Utah, Salt Lake City, under the auspices of the Rocky Mountain Electrical Co-operative League, approximately a hundred members, representing various branches of the industry, were in attendance. Sidney W. Bishop, the executive manager of the league, outlined its many activities, and the "get together" spirit prevailed.

## Associations and Societies

**New England Division, N. E. L. A.**—The New England Geographic Division of the National Electric Light Association will hold its next convention at Swampscott, Mass., on Sept. 6-8.

**Iowa Section, N. E. L. A.**—The annual convention of the Iowa Section, N. E. L. A., and the Iowa Electric Railway Association will be held at the Hotel Hanford, Mason City, Iowa, on June 20, 21 and 22.

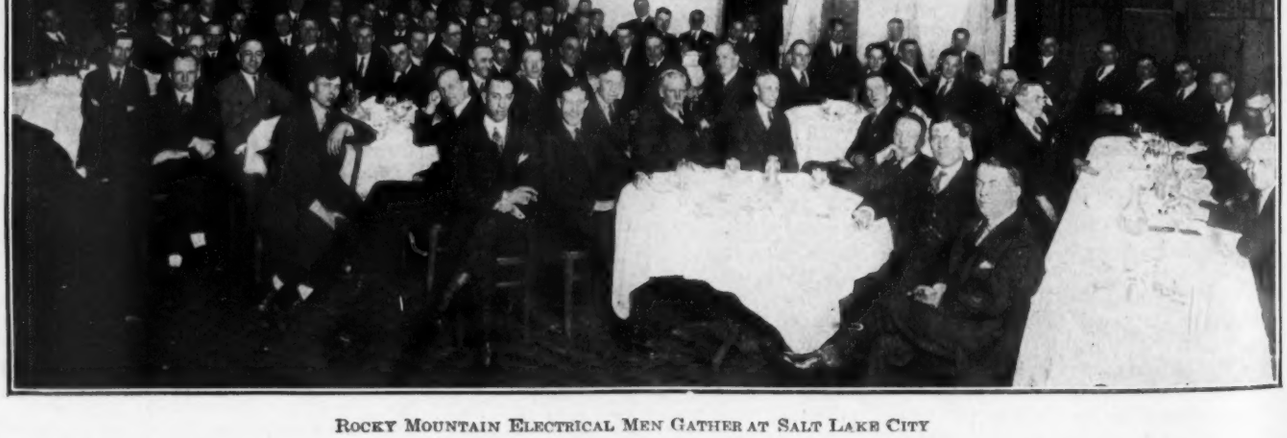
**Pacific Coast Electrical Association.**—Plans for the seventh annual convention of the Pacific Coast Electrical Association, to be held in San Francisco June 19-23, have been put into shape. The opening day will be devoted to registration, and in the evening motion pictures will be presented. On June 20 James B. Black will give the president's address. Technical and Commercial Section meetings will be held in the afternoon and continued on the morning of June 21. The second business session will be held on the next morning, and the Western conference is scheduled for the afternoon with the banquet in the evening. On Saturday the delegates will take a trip up Mount Tamalpais and into Muir Woods.

**American Electrochemical Society.**—When this society assembles at the Commodore Hotel, New York, on Thursday, May 3, there will be a session devoted to reading and discussing seven papers on electrode potentials. Papers on electrodeposition will follow in the afternoon. On Friday, among other papers, will be "Heat-Insulating Material for Electrically Heated Apparatus," by J. C. Woodson; "Methods of Handling Materials in the Electric Furnace and the Best Type of Furnace to Use," by Frank W. Brooke; "Relation Between Current, Voltage and the Length of the Carbon Arcs," by A. E. R. Westman, and "Electric Furnace Detinning and Production of Synthetic Gray Iron from Tinplate Scrap," by C. E. Williams, C. E. Sims and C. A. Newhall. "Production and Application of the Rarer Metals" will be general subject of eight papers on Saturday.

### Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See Jan. 6 issue, page 78, for latest list.]

American Electrochemical Society — New York, May 3-5. Colin G. Fink, Columbia University, New York.
Nebraska Section, N. E. L. A.—Omaha, May 10-11. Horace M. Davis, Lincoln.
Southwestern Public Service Association—Fort Worth, Tex., May 15-17. E. N. Willis, 403 Slaughter Bldg., Dallas, Tex.
Empire State Gas and Electric Association, Electric Section—Utica, N. Y., May 17-18. C. H. B. Chapin, Grand Central Terminal, New York.
Electrical Supply Jobbers' Association—Executive committee and general meeting, Hot Springs, Va., May 21-25. Franklin Overbagh, 411 S. Clinton St., Chicago.
Missouri Association of Public Utilities—River boat from St. Louis to Peoria, May 24-26.
American Society of Mechanical Engineers—Montreal, May 28-31. C. W. Rice, 29 West 39th St., New York.
National Electric Light Association—New York, June 4-8. M. H. Aylesworth, 29 West 39th St., New York.
California State Association of Electrical Contractors and Dealers—Dorner Lake, Cal., June 9-16.
Electric Power Club — Hot Springs, Va., June 11-14. S. N. Clarkson, Kirby Bldg., Cleveland.
North Central Division, N. E. L. A.—Minneapolis, June 13-15. H. E. Young, Minneapolis General Electric Company.
Pacific Coast Electrical Association—San Francisco, June 19-23. S. H. Taylor, 527 Rialto Bldg., San Francisco.
Society for the Promotion of Engineering Education—Ithaca, N. Y., June 20-22. F. L. Bishop, University of Pittsburgh.
Canadian Electrical Association — Montreal, June 20-23. Louis Kon, 65 McGill College Ave., Montreal.
American Institute of Electrical Engineers—Annual convention, Swampscott, Mass., June 25-29; Pacific Coast convention, Del Monte, Cal., Oct. 2-5. F. L. Hutchinson, 33 West 39th St., New York.
American Society for Testing Materials—Atlantic City, June 25-29.
Associated Manufacturers of Electrical Supplies—New London, Conn., June 26-29. Frederic Nicholas, 30 East 42d St., New York.
National Council Lighting Fixture Manufacturers—Buffalo, June 26-28. C. H. Hofrichter, 233 Gordon Square Bldg., Cleveland.
Northwest Electric Light and Power Association—Seattle, June 27-30. G. E. Quinan, 204 Electric Bldg., Seattle.
Ohio Electric Light Association — Cedar Point, July 10-13. D. L. Gaskill, Greenville.



ROCKY MOUNTAIN ELECTRICAL MEN GATHER AT SALT LAKE CITY

# Recent Court Decisions

**Assumption of Risk in Pole Climbing.**—The District Court of Appeal of California found, in Richardson vs. Southern Pacific Company, that where the plaintiff, an experienced telegraph lineman, ordered to ascend a pole, called his foreman's attention to surface rot at the foot of the pole, but the foreman assured him that the pole was all right, and plaintiff was injured by the breaking of the pole, plaintiff had not assumed the risk as a matter of law and the question of contributory negligence was one for the jury. (212 Pac. 959.)*

**Hearings Under Florida Commission Law.**—The United States District Court at Jacksonville, Fla., found, in Jacksonville Gas Company vs. City of Jacksonville, that the act providing for the fixing of rates by the City Commission of Jacksonville, and for appeal to the Railroad Commission, did not deny the company due process of law in violation of the Fourteenth Amendment, in according no hearing to the company, inasmuch as the company had the prescribed notice and had opportunity to appeal to the Railroad Commission, where it could have had a hearing. (286 Fed. 404.)

**Public Interest in Preventing Bankruptcy of Utility.**—Dismissing injunctions found in the lower court, the Court of Appeals of Kentucky found, in Stafford vs. Johnson County Gas Company, that where it appeared that a utility company was losing money and could probably not continue to operate, or would be forced into bankruptcy, if the rates were not increased, the interest of the public in continuance of the service was a good and valid consideration for the enactment by the board of trustees of the town of Paintsville of ordinances amending the franchise so as to permit the company to charge increased rates. (248 S. W. 515.)

**Evidence of Negligence Justifying Submittal of Damage Suit to Jury.**—Sustaining a verdict of $10,000 damages in Graham vs. City of Ames for the death of a young man who came in contact with a broken transmission wire of the municipal plant and was killed in an alleyway while delivering papers in the early morning, the Supreme Court of Iowa held that the lower court did right in refusing a directed verdict. Three grounds for the charge of negligence against the city were submitted to the jury, rightly as the Supreme Court held: (1) That the defendant had constructed its line out of inefficient material and that it was inadequate for the service required; (2) that the defendant had failed to use diligence either to repair the broken wire or to shut off the current therefrom; (3) that the defendant had failed to equip its plant with suitable devices to enable it to discover promptly a break in its primary wires. The contention that pedestrians had no right to use alleys as a path was overruled. The presumption, in the absence of any eye witness to the accident, was that the victim used due care. (192 N. W. 299.)

**Powers of West Virginia Commission.**—In Berkeley Springs Waterworks vs. Public Service Commission of West Virginia, an experimental order of the commission valuing the plant of, and fixing the rates to be charged by, a public utility, and retaining the case on the docket for future report and action after the results of such experiment are ascertained, was not final, according to the ruling of the Supreme Court of Appeals of West Virginia, and an appeal therefrom to the court was dismissed, without prejudice to further action thereon by the commission. (116 S. E. 140.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

# Commission Rulings

**Special Rate for Surplus Power Supplied to One Customer Only Cannot Be Granted.**—The Wisconsin Railroad Commission has refused to allow a special surplus power rate to be made to the Dells Paper & Pulp Company of Eau Claire, on the ground that such a rate cannot be granted where only a single customer would benefit.

**Historical-Cost Valuation Method Defended.**—The New Hampshire Public Service Commission in investigating the rates of the Exeter Water Works declared its belief that the historical cost of a plant is always more satisfactory as a measure of value than the reproduction cost, since the first is based upon facts while the latter is based upon estimates which at most are only intelligent guesses; but, the commission added, the enhanced value due to present prices must receive due consideration.

**Free Service for Right-of-Way Illegal.**—Free service as part of the consideration for a right-of-way is unlawful, according to a decision of the Pennsylvania Public Service Commission in complaints made against the Manufacturers' Light & Heat Company. It held that the facts that the grantor in the contract was an individual instead of a municipal corporation and that the thing granted in consideration of the free service consisted of a right-of-way over private property instead of a municipal franchise on or along public streets did not take the case out of the scope of the legal principle involved in cases where free service to municipalities had been discontinued. The question was also presented whether the public utility while refusing to deliver free service could continue to occupy the right-of-way. The commission stated its opinion that the question raised on this ground was judicial and beyond the scope of the commission's jurisdiction.

**Basis for Overhead Allowance.**—According to a decision of the Vermont Public Service Commission concerning the Rutland Railway, Light & Power Company, a percentage allowance for overhead expense in an estimate of original cost should not be based on the depreciated value of the property. "The services of engineers and superintendents," the commission said, "were rendered upon the original construction; therefore, if the amount to be allowed is computed on a percentage theory, the proper base is original cost and not the value of the property as it might be after years of use."

**City May Intervene in Action to Raise Franchise Rates.**—The New York Public Service Commission held in considering a petition from the Peekskill Lighting & Railway Company to increase fares that the municipality had a right to intervene in an endeavor to maintain the franchise rates. "The reference in the statute to the rate theretofore prescribed by local municipal consent and the requirement that the commission shall regard the estimated earning capacity of the property under that rate show to my mind," said the commissioner who handed down the decision, "that the contract or franchise rate is one that the municipality has a clear right to come in and defend. The rate so fixed by the franchise or contract is, in my opinion, a binding rate until on facts shown to the commission it shall determine that in the public interest a different fare is necessary for the safe and adequate service of the public. On this question and on this proof the municipality has a right to be heard."

**Dividing Line Between Responsibility of Commission and of Company Management.**—In adjusting a complaint made against the Philadelphia Rapid Transit Company, the Pennsylvania Public Service Commission adverted to the danger of a commission infringing on what is properly managerial territory, saying that the commission's duties "are not to be performed by its assuming managerial control over public utilities, nor by substituting its judgment for theirs in the performance of those things for which, for the public benefit, the law holds these utilities responsible. The line of demarcation between the duty of a company to exercise its managerial judgment and the responsibility resting upon this commission to regulate is established where the utility is exercising its initiative responsibility in a way which adversely affects the public. The commission must exercise care that it does not relieve utilities by its orders of a managerial duty which they ought to perform and of a responsibility which, if they are to function properly in public service, must continue to be theirs."

# Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men
Engaged in all Branches of the Electrical Industry

## D. Farrand and J. L. O'Toole Made Vice-Presidents

Dudley Farrand and John L. O'Toole, assistants to the president of the Public Service Corporation of New Jersey, were elected vice-presidents of the Public Service Corporation of New Jersey at the annual meeting on April 18 of the directors of the company and twelve subsidiaries. Mr. O'Toole became connected with the Public Service Corporation in 1909, after having been in newspaper work in Newark for seventeen years. For nine years prior to becoming publicity agent for the corporation he was city editor of the Newark *News*. In 1917 his title was changed from publicity agent to assistant to the president. Mr. Farrand has been with the predecessors of the Public Service Electric Company and with the corporation continuously since 1887. He was first elected a director and assistant treasurer of the Newark Electric Light & Power Company. In 1895 he became assistant general manager of the People's Light & Power Company and three years later its general manager.

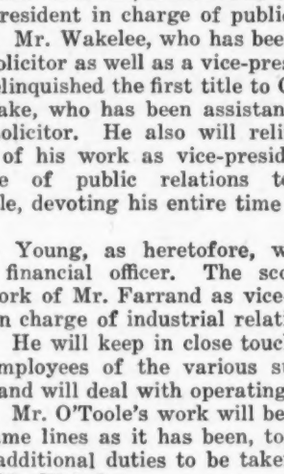
The following year Mr. Farrand became general manager of the United Electric Company of New Jersey and in 1903, the year of reorganization, he was made general manager of the electric department of the Public Service Corporation. In 1910 Mr. Farrand was made general manager of the Public Service Electric Company and five years later was made its vice-president and general manager. In 1917 he also was made assistant to the president. Mr. Farrand was president of the National Electric Light Association in 1907 and the following year was appointed by President Roosevelt as technical adviser representing the electrical interests to the National Conservation Commission.

The election of Messrs. O'Toole and Farrand was announced with other important changes in the staff of officers of the Public Service Corporation. Thomas N. McCarter was re-elected president of the corporation and subsidiaries for the twenty-first consecutive term. Vice-presidents Randell Morgan of Philadelphia and Colonel Anthony R. Kuser of Bernardsville, both of whom have been officials of the company for about fifteen years, resigned. They will continue as members of the board of directors of the corporation and as members of the executive committee.

Under the reorganization plan Percy S. Young is vice-president in charge of finance, Edmund W. Wakelee is vice-president in charge of law, Dudley Farrand vice-president in charge of industrial relations, and John L. O'Toole vice-president in charge of public relations. Mr. Wakelee, who has been general solicitor as well as a vice-president, has relinquished the first title to George H. Blake, who has been assistant general solicitor. He also will relinquish some of his work as vice-president in charge of public relations to Mr. O'Toole, devoting his entire time to the law.

DUDLEY FARRAND

Mr. Young, as heretofore, will be chief financial officer. The scope of the work of Mr. Farrand as vice-president in charge of industrial relations is wide. He will keep in close touch with the employees of the various subsidiaries and will deal with operating problems. Mr. O'Toole's work will be along the same lines as it has been, together with additional duties to be taken over from Mr. Wakelee.



J. L. O'TOOLE

## R. E. Danforth Heads New Power Company

Richard E. Danforth, vice-president and general manager of the Public Service Railway, Newark, N. J., has been elected president of the Public Service Electric Power Company, a subsidiary of the Public Service Corporation of New Jersey. Mr. Danforth retains his executive position with the railway company. The following officers were also elected: Henry D. Whitcomb, vice-president; William H. Feller, secretary, and Frederick A. Neis, treasurer.

**C. I. Rhodes,** formerly chief of the hydraulic division of the California Railroad Commission, has resigned to become associated with Chester H. Loveland, consulting engineer of San Francisco.

**Joseph Pope** has been transferred from the power-station betterment division of Stone & Webster, Inc., Boston, to steam-power plant research. His former position as head of the betterment division will be filled by Walter H. Balcke.

**R. A. Bruce** has succeeded F. J. L. Doyle as assistant secretary and assistant treasurer of the West Virginia Utilities Company and as auditor and assistant treasurer of the Wheeling Public Service Company, both in Wheeling, W. Va.

**George W. Wood,** formerly manager of the Mansfield (Mass.) Municipal Lighting Department, is now associated with the C. D. Parker Company, bankers, of Boston, who operate the Fibreboard Company, manufacturer of a patented leather-fiber board. Mr. Wood is stationed at the Fibreboard Company's Amesbury plant.

**Henry Trumbower,** member of the Wisconsin Railroad Commission since 1916, has resigned, effective May 1, to accept an appointment with the United States Department of Agriculture in charge of an investigation of the economics of transportation as it relates to marketing and distribution of farm products.

**K. E. Van Kuran,** district manager of the Westinghouse Electric & Manufacturing Company, and R. E. Fisher, vice-president of the Pacific Gas & Electric Company, both of San Francisco, have been appointed a committee of two to arrange for transportation to the annual convention of the National Electric Light Association to be held in New York City June 4-8.

**Howard S. Snell** has been appointed chief engineer for the Montana Public Service Commission to fill the vacancy caused by the resignation of James H. Bonner. Mr. Snell goes to the Montana commission with twelve years' experience in public utility work. He was engineer for the Public Service Commission of Kansas for three and one-half years and was consulting engineer for the Kansas City, Mexican & Orient Railway Company. He has had five years' experience in valuation of utility properties.

### W. H. Taylor Made General Manager

W. H. Taylor, vice-president of the Georgia Railway & Power Company, Atlanta, has been appointed general manager of the business of the company. He will be designated as vice-president and general manager and will have general supervision over various departments, assisting H. M. Atkinson, chairman of the board, and P. S. Arkwright, president.

**I. A. Rosok** has succeeded H. B. Johnson as manager of the Bisbee (Ariz.) Improvement Company.

**Kurt C. Barth,** formerly associated with the Barrett Company, which was recently taken over by the Allied Chemical & Dye Stuff Company, has been appointed Eastern manager at Chicago for the E. T. Chapin Company, Spokane, Wash.

**Calvert Townley,** assistant to the president of the Westinghouse Electric & Manufacturing Company, has been re-elected a vice-president of the American Engineering Council and has been appointed a member of its finance and public affairs committees.

**G. H. Froebel,** manager of the Houston (Tex.) branch office of the Westinghouse Electric & Manufacturing Company, has been appointed manager of the marine sales department. Mr. Froebel's headquarters will be at East Pittsburgh.

**R. T. Gordon,** who for the past eight years has been connected with the Alberger Pump & Condenser Company, has resigned to join the sales department of the Dean Brothers Company of Indianapolis, manufacturer of pumping machinery, and will be with its New York office.

**Carl O. Martin,** formerly in charge of the Northwest territory of the Benjamin Electric Manufacturing Company, has been transferred to a larger field with headquarters in San Francisco. There he will be assistant to Miles F. Steel, Pacific Coast manager for the company.

**A. S. Childs** has resigned as sales manager of the Cooper Hewitt Electric Company after twenty years' association with that company. Charles F. Strebig, formerly manager of the Philadelphia office, succeeds Mr. Childs as sales manager. Mr. Strebig has been with the company fifteen years.

**William H. Welch,** formerly manager of the Hartford (Conn.) branch of the Electric Supply & Equipment Company, has been appointed sales manager of the Hartford Electrical Supply Company. M. G. Francoeur has been appointed sales promotion manager of the latter company. E. F. Irlbacker, formerly manager of the fixture department, has resigned from the company.

**Henry D. Jackson,** formerly electrical and mechanical engineer with Monks & Johnson, engineers of New York and Boston, and William P. Mower, his assistant on the mechanical work, are leaving the organization to associate themselves with W. R. Templeton in the manufacture and sale of the "Templeton" return and boiler-feed trap.

**J. H. Klinck** has been appointed assistant supervisor of production of the Westinghouse Electric & Manufacturing Company. Mr. Klinck, who has had wide experience in electrical and general engineering and sales work, has been associated with the Westinghouse company since 1904, when he joined the industrial and power sales department.

### R. Collier Leaves Poughkeepsie

Rawson Collier, general sales manager of the Central Hudson Gas & Electric Company and affiliated companies, with offices at Poughkeepsie, N. Y., has resigned to join the organization of Dwight P. Robinson & Company, Inc., engineers and constructors, New York, on May 1. Prior to his connection with the Central Hudson Gas & Electric Company, Mr. Collier was for five years a member of the firm of Collier & Brown, consulting engineers, Atlanta, leaving this firm to become connected with the Georgia Railway & Electric Company. Here his work covered sixteen years, during which time he was connected with practically every department in the company. At the time of leaving he was general sales manager of the company. Mr. Collier is a graduate of the Massachusetts Institute of Technology, and for a number of years he has been prominently indentified with the work of the National Electric Light Association, the American Institute of Electrical Engineers, the American Gas Association and the Illuminating Engineering Society.

RAWSON COLLIER

**August Lutz,** Oakland manager of the Pacific States Electric Company, was recently elected president of the Electric Club of Oakland.

**C. H. Kurz,** has been appointed to succeed Dyer Thomas as the manager of the Federal Electric Company in Denver, the latter having been transferred to Detroit as sales manager of the company.

## Obituary

**William F. McNally,** president of the Crookston (Minn.) Water Works, Light & Power Company and of the Manistique (Wis.) Light & Power Company, died recently at his home in New Richmond, Wis., at the age of sixty-three. Mr. McNally's life was largely devoted to the practice of law.

**John Gilbert Ward,** for thirty years treasurer of the Babcock & Wilcox Company, died on Sunday at his home in Glen Ridge, N. J. Mr. Ward entered the treasurer's office of the Babcock & Wilcox Company as a clerk in 1888, later becoming assistant to the treasurer, and in 1893 he was elected treasurer and a director of the company. He was sixty-eight years of age.

**Samuel C. D. Johns,** identified for thirty-five years with the Cleveland Electric Illuminating Company and its predecessor, died on April 20 after a brief illness. Mr. Johns was secretary of the company when he retired in 1918. He was born in England but educated in Cleveland. Previous to his association with the power company he had been a railroader and telegraph operator. Mr. Johns was eighty years of age.

**C. F. Beames,** consulting engineer with the Columbia Gas & Electric Company, New York City, died suddenly on Sunday, April 22. Mr. Beames was at one time connected with the General Electric Company at its Schenectady and Chicago offices and later was sent to Mexico. Subsequently he allied himself with the Mexican Gas & Electric Light Company in Mexico City. Later Mr. Beames became associated with the J. G. White Corporation in Porto Rico and also was connected at one time with the Electric Bond & Share Company. During the war he was lieutenant-colonel in the Ordnance Department, U.S.A.

**Thomas C. Gordon** of Little Falls, Minn., died at his home in that city on April 16 after a year's illness. Mr. Gordon became associated with the Little Falls Water Power Company in 1887. In 1889 he was made secretary-treasurer, and in 1903 the duties of general manager were conferred on him. In 1918 Mr. Gordon disposed of his interests in the water-power company and shortly thereafter engaged in the automobile and garage business. In addition to his duties with the Little Falls Water Power Company and the Gordon Motor Company, he found time to take an interest in many other business ventures. He was instrumental in forming the Morrison County Electric Light, Heat & Power Company, now out of existence, and was its secretary-treasurer. He filled the same office for the Pike Rapids Hydro-Electric Company, which owned and controlled a power site a few miles below the city.

# Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

## Pruning the Wiring-Device Line

### How Excess Varieties Are Crippling the Electrical Trade—What One Manufacturer Has Done—Great Promise if Courage Lasts

By Earl E. Whitehorne
*Commercial Editor* Electrical World

THE other day in the office of a prominent jobber of electrical supplies I saw three piles of inventory cards stacked up in the corner. Each card represented a different item in that jobber's stock. On the card were entered the number of units and the quantity of that commodity in stock at the time of the January inventory. Two of these piles reached a little over three feet up the wall; the other was two feet high. The two big piles represented the articles that were to be continued in stock. The short pile represented obsolete material that was to be thrown out of stock. In short, the obsolete material in that jobber's stock on the first of January had amounted to about one-fifth of his entire line, in number of varieties—say 1,500 items out of a total of 7,500. Because this man is progressive and a firm believer in the present movement for simplification in the jobbing line, he is going to quit selling these obsolete types, although some demand still continues. But Heaven knows how many excess and duplicating varieties he will go on carrying on his shelves. The noose is still around his neck and the manufacturer holds the business end of the rope.

#### The Epidemic

The disease with which the electrical jobber has been suffering for a number of years can undoubtedly be diagnosed as congestion of stock—with complications. He caught it from the electrical manufacturer. The electrical manufacturer contracted the disease as the result of a bad habit. He had begun in the early days to manufacture a socket, a receptacle, a conduit fitting, or, say, a fuse, and developed a necessary line. Then people began asking for special stuff. He made it because it seemed to be needed and because it was profitable to make it—which was quite proper. But instead of calling it "special," he made the fatal error of listing and picturing all this special stuff in his catalog as standard. "Watch my line grow!" he said. "I'm getting ahead!" Naturally people saw these new varieties and asked the jobber for them. The jobber began to stock them, but because they were special fittings for unusual needs there were few orders. But this slow-moving stock has grown as every manufacturer in almost every line has madly proceeded with this competition for bigger lines until finally excess varieties began to choke the industry to death.

Jobbing stocks had swollen until one jobbing house at least today is listing over 50,000 items, and catalogs of 12,000 and 20,000 are common. And because they have been smothered under this load of varieties, jobbers, sales managers and salesmen have been demoralized into a class of overburdened order takers. For what man can do creative selling and develop a market for 50,000 articles—or 7,500?

Too many manufacturers have been making too many articles in too small volume. Too many jobbers have been selling too many varieties in too small volume. And to try to get more volume manufacturers have gone on giving opportunity to too many semi-jobbers to compete with established houses. And the jobbers in turn have been selling to anybody to get an order and building up "curbstone" competition for their best contractor customers. And there you are!

#### Jobbers Have Decided to Act

But the worm will turn. The burden has grown too heavy for either manufacturer or jobber. So for some time each has been calling on the other to do something toward simplification. "Stop ordering these excess varieties and selling them!" the manufacturer has said. But he has continued to list these varieties and send his catalogs into the jobber's territory.

Therefore the trade has continued to order them and the jobber has gone on selling them. It was inevitable, however, that both parties to the situation should ultimately be compelled to do something to help themselves.

Last February the executive committee of the jobbers' association called upon all its commodity committees to study the opportunities for the elimination of excess, obsolete and duplicating varieties in each line and bring in definite recommendations at the coming meeting of that association in Hot Springs, Va., next month, specifying what the jobber himself should do and what the manufacturer should do. Meanwhile a few manufacturers also have decided to quit discussing it and act. Here is a good example in the wiring-devices line.

#### One Manufacturer's Discovery

It was decreed by the executive of one of the largest manufacturers that their line should be reduced. They had listed in their catalog the following articles:

| | |
|---|---|
| 344 | sockets |
| 236 | receptacles |
| 269 | switches |
| 82 | plugs and receptacles |
| 29 | rosettes |
| 421 | cut-outs and fuses |
| 1,381 | devices in all |

When the pencil was sharpened and they went to work, they found that they could eliminate as either obsolete or duplicating or unnecessary excess varieties:

| | |
|---|---|
| 175 | sockets |
| 192 | receptacles |
| 77 | switches |
| 51 | plugs and receptacles |
| 20 | rosettes |
| 107 | cut-outs and fuses |
| 622 | devices in all |

This left in the line as essential:

| | |
|---|---|
| 169 | sockets |
| 44 | receptacles |
| 192 | switches |
| 31 | plugs and receptacles |
| 9 | rosettes |
| 314 | cut-outs and fuses |
| 759 | devices in all |

Even this was not all. They went back at it again, and when they had analyzed the line once more over 800 numbers had been eliminated. Some were sockets or receptacles or switches that were obsolete. Some were practically duplicates of other numbers. Some were varieties popular in one section but differing only superficially from another number that is in general demand elsewhere. They were all excess varieties. For instance the entire line of standard-depth switches was eliminated, and the standard numbers were given to the shallow switch line. The trade was notified that only shallow switches would be shipped thereafter because shallow switches will do all that the deep ones will do.

### THE ECONOMIC LOSS

A group of jobbers got together and studied the lines of schedule material cataloged by four different manufacturers. They decided that these eliminations could be made:

| | |
|---|---|
| Manufacturer A- | 553 varieties |
| Manufacturer B- | 350 varieties |
| Manufacturer C- | 239 varieties |
| Manufacturer D- | 247 varieties |

One of these jobbers, who by the way had argued for 100 more eliminations, said: "This means that those manufacturers are listing, advertising, cataloging and keeping forms, castings, patterns, etc., to manufacture these obsolete items whenever demanded. The same thing is true with the jobbers. They carry the articles in stock, where they take up room on shelves that is valuable and costs money; they put them in their catalogs. If they have ten of an item in stock and get an order for ten or fifteen, they order a standard package of possibly as many as 500 to rot on their shelves and increase their overhead. The ultimate consumer could be better served at lower costs if these duplications were eliminated.

"We haven't got very far with the manufacturers themselves," he continued. "They all appear to be afraid of each other, yet you talk to them all individually and personally and they seem to be for it. When you get through talking to them, go home and write them a letter; however, each one comes out and tells you that an ideal result could be accomplished if all would work together, but that he can't do it because he is afraid of the other fellow.

"As I see the proposition, the only thing to do is to arouse a public opinion against these expensive duplications and do away with them, or go down to Washington and demand that the government practice a little paternalism. But I don't believe the government would dabble in a matter of this kind unless the manufacturers compel it by their indifference."

A JOBBER'S INVENTORY—7,500 CARDS

The short pile, 20 per cent of the entire line, represents obsolete varieties which can be eliminated.

### WHOSE MOVE IS IT?

One manufacturer, in discussing the problem recently, said to me: "The matter can be better handled by the consumer or the distributor than by the manufacturer. The manufacturer must continue to supply any demand. A campaign of general educational work carried on by every one interested can do a great deal by removing the demand. We are always ready to meet our customers or distributors half way." In that attitude, I believe, lies the source of much of the difficulty, but as a matter of actual fact the manufacturer does not meet any demand any more than a street car runs up any street because somebody wants it to. There is always an end to any line and it is the manufacturer who sets the point where the line stops.

The trouble is that he hesitates to take the drastic step, even though he knows that it will save him money on production. To quote a jobber who has thought much on the subject: "Three or four manufacturers can take a decisive step and put it over, whereas 200 distributors pulling this way and that will accomplish nothing. One distributor says that some device is a good seller; another says that it is not. It doesn't matter who is right. The manufacturer for economic reasons can refuse to make it, catalog it or sell it and the deed is done. Both distributors will from then on sell the remaining variety with no less success."

### ONLY COURAGE NEEDED

One manufacturer wrote to me: "There is much to be said for it. However, on the other hand, much against it—etc., etc.," which is a pretty good example of what the general attitude has been in recent years. In the meantime the burden of excess varieties has been getting steadily worse. More refinements and improvements and extensions have been added to the line—every line—and few taken off the market, and, of course, this has been no less the fault of the jobber than the manufacturer. One jobber recently put it in these words: "The manufacturer naturally has objected to eliminating some numbers that have been good sellers with us, for instance. However, we know that many of these items continue to be good sellers here because we do not direct customers to the selection of proper products and they are left to buy at random anything we may show in our catalog."

All this refers not alone to sockets, receptacles and switches. It applies to fuses, to conduit fittings, to insulators, to lamps, to reflectors, to as many other lines as you can count on your two hands. Why should there be both galvanized and black outlet boxes, why both galvanized and black pipe—when galvanized is better and would be cheaper if the product were made in that style only? Why should there be five kinds of heater cord?

The economic principle involved in all of this is unassailable. Any one who does not believe it need but look through any jobber's stock or catalog. The only question is with the individual. Has he the moral courage to act on principle and tell his salesmen and his customers and his suppliers or his distributors that they must stop doing something that is not good for all of them? It is encouraging to see that some manufacturers at last have had the nerve to face the situation and proceed to clean up their own lines and free themselves from the dragging chains with which these excess varieties so long have hobbled them.

# Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

CONTINUED expansion of business characterizes virtually all branches of the electrical trade. Conservative financing and careful buying by manufacturers and jobbers are keeping most sections of the country reasonably free from inflation, and although increasing scarcity of labor is being felt, production is at a high rate and transportation conditions are much improved on railways. Important central-station construction is under way in southern New England, and work is being rapidly pushed on some trunk-line high-voltage interconnections. Wire factories and electrical machinery makers are working close to capacity, and appliance and specialty makers are crowded with orders. Central-station outputs are growing by leaps and bounds. House-wiring developments are in immense volume, and there is little sign of recession in the equipment of old houses or the building of new ones. Here and there industrial-plant expansion is beginning to take on the appearance of war-time plant development. Manufacturing in general is on a full-time basis. The textile industries are working very near capacity and the metal-working establishments are busy caring for past orders, new business being obliged to face a lengthening delivery situation. Retail trade is improving with better weather and easier highway travel. Non-employment is scarcely heard of, and recent wage increases in the textile field appear to have been promptly translated into increased buying of commodities. Electrical appliances are in greater demand, and popular interest in the "electrical home" movement and in better home displays is finding an outlet in growing purchases of electrical labor-saving devices and comforts.

## Irons for Reserve Purposes a Feature of Present Market

SALES of electric flatirons continue to be well maintained and deliveries are reported as very satisfactory. These devices are probably first in popularity after the electric lamp, and the point of local saturation seems as far off as ever in many electrical utility areas. A feature of this spring's business is a tendency toward ordering a duplicate iron or a unit of a second make for reserve purposes in the home. Retailers apparently have not attempted to push irons on this basis to a great extent, and the realization of the convenience of a second outfit in the ordinary home has come largely from satisfied users. New designs in irons are coming into the market this spring and arousing much popular interest. Price conditions appear to have little bearing upon sales developments, and there seems to be a market for American irons of diversified quality and reputation. Some central-station tests of cheaply made and inferior makes of irons, especially of German "extraction," have been a powerful deterrent to the flooding of the American market with unsuitable products.

## Tool Makers Advising Customers to Anticipate Requirements

MANUFACTURERS of electric tools are finding some difficulty in obtaining prompt delivery of certain sizes of steel, which makes it necessary for them to increase their stocks of raw material to provide against delays. Prices on their lines are stiffening, skilled labor is increasingly difficult to obtain, and wages are on the upward trend. These manufacturers are advising their customers to anticipate their requirements as far ahead as possible to avoid disappointments or non-delivery. Makers of belts and safety straps are experiencing considerable difficulty in getting enough leather to keep up with the present unusual demand.

## Electric Refrigerating Outfits Moving Well

CONSIDERABLE activity in manufacturing circles devoted to the production of electrically driven refrigerators is apparent as the warmer season approaches. Interest among central-station power sales departments has begun to quicken as a result of renewed efforts of manufacturers to develop a wider line of equipments suited to more moderate-sized homes than were the large outfits put earlier on the market. New apparatus has lately been brought out with remarkably simple mechanical details in comparison with former designs, and while it would be exaggeration to state that the smaller residence can at present be supplied with refrigeration at low cost from the investment standpoint, the trend of development is in that direction. For many years the development of such equipment centered around hotels, markets, fruit establishments and provision houses; gradually equipments began to appear suited to large residences, and today the outlook is bright for a great advance in electric cooling applications into the field of the medium-sized home. Some of the apparatus available may fairly be said to have settled down to a standard production basis, and as the market widens the costs of development will be absorbed by sales and the development of much smaller machines hastened.

## Heater Sales Reported Dull in New England

SPRING sales of electric heaters for socket attachment have been rather slow during the past few weeks, although the coal situation has cleared only gradually. Distributors and retailers were prepared to handle a considerably larger business than materialized. Weather conditions appear responsible in part for this falling off in demand, there having been few sudden and sharp drops in temperature and more even conditions than usual for this season. In trade circles the opinion is generally held that the fall is the best time to push heaters at retail, but with fuel costs at present high levels, and with a growing popular appreciation of the sphere of usefulness of heating apparatus in the home and in special locations in industry, there appears to be a potential market which can be uncovered by more energetic sales effort. Stocks are likely to be drawn down somewhat by sales of heaters for summer camps in this section, but the outlook for early purchases for warehousing purposes is not very bright. A good business is expected after the vacation season, but the present market is without feature.

## Variety of Demands for Magnet Wire Increasing Weekly

PRODUCERS of enameled wire report vigorous activity. The automotive industry is a large buyer and the radio manufacturer is also keenly interested in high-grade material of marked space economies. The variety of demands for magnet wire, both enameled and non-enameled, increases almost weekly, and in representative plants production has to be upon a practically continuous basis to satisfy current requirements. Raw-material costs are stiffening at this time, and prices are relatively unstable. The higher quality material tends to sell upon its merits, however, and builders of motor cars and other products who exercise discrimination in the selection of their material are contributing to the stabilization of the market when they purchase wire in mass or in coil form on the primary basis of quality. This has no direct appeal to some purchasing agents, apparently, but the preparation now given high-grade wire for use in automobile service and other important applications warrants thorough study of the material and more appreciation of processing requirements on the part of users.

## Farm Lighting Sets Are Expected to Move Faster

REPORTS of farm-lighting-set sales for the first quarter of 1923 indicate a much healthier trade than a year ago, and now that highway conditions in the rural districts of the north are improving, sales activity seems certain to increase still more within the next few weeks. It is not easy for the manufacturer or distribu-

tor in a city or large town to visualize some of the difficulties which accompany sales work in the field during the winter and early spring, under conditions where road travel is bad. In one Northern state last week a salesman started from a small town by motor to a sales district only 20 miles away, leaving at 8 a. m. He arrived at 8 p. m., after a day's battle with muddy roads and an outlay of some $20 for haulage. In the locality where this took place conditions will improve rapidly during the next fortnight, but the absence of convenient railroad service and sometimes the total lack of train facilities in such regions, coupled with highway difficulties, makes it costly and trying to sell this kind of equipment in areas far from central-station lines. It is done, none the less.

## Farm Sets Help Introduce Electric Service

REPORTS are coming in to the effect that in not a few communities the entrance of farm-lighting outfits is regarded with satisfaction by near-by central-station systems at present unable to reach these consumers except at excessive outlay. There appears to be a more cordial relationship between central-station sales departments and the farm-lighting-set representatives than was evident a while back. Some problems of difficult character remain in this relationship and in relation to the future customer and his equipment; but, on the whole, a leading distributor states, the outlook is gratifying and constructive in its possibilities. Local stocks of sets are, on the whole, well prepared for the spring and summer business. Prices are firm and may advance later, according to widespread ideas of the trend of costs. Year by year this class of equipment finds a growing market, and replacement business is a factor of increasing importance in the older sets, especially along the line of new battery plates. Optimism as to 1923 business was very generally manifested by those who attended one of the larger factory sales conferences in this line of equipment production a week or two ago.

## New England Collections Show General Improvement

IMPROVED credit conditions are still evident in New England, and increased discounting of bills is reported by jobbers. Railroad, public utility and large industrial-plant buying is on a more satisfactory basis than for a long time. Some contractor-dealer accounts are reported as slow, but underlying conditions are unusually good. Credit managers are working hard to keep conditions favorable as long as possible, and nothing like a "wide-open" policy can be discerned when expansion is proposed. Throughout this territory a tendency toward careful buying has unquestionably helped the credit situation. A few weeks ago collections were handicapped by severe weather and excessive delays in freight shipments, but these conditions are rapidly yielding to better transportation achievements and a rising tide of new business. While some contractor accounts run as high as ninety days, a fair average is about sixty. Much good work is being done by jobbers along the line of helping to stabilize retail business methods.

## Magnetic Clutch Sales Active with Advance Into Paper Field

VIGOROUS activity in the sale of magnetic clutches is reported in leading manufacturing circles, and the advance of this class of equipment into the paper-making field is a recent development that has been more or less overlooked. While a large part of the business in this line of products involves specialized engineering design and intelligent application analyses for lasting sales, the broader development of clutch production to include a wider contact with the requirements of the machine-tool industry is on the way, and a degree of standardization appears to be at hand. As in most other apparatus lines, prices are firm, labor none too plentiful in the factories, and deliveries not yet on a stable basis, although anticipation of raw material requirements and improving transportation conditions are working in favor of the buyer.

## Diversified Demand for Control Apparatus

WIDENING applications of control equipment are contributing to put manufacturers in this class of electrical products upon a plane of production taxing all their present facilities. The growth of motor sales and tendency toward the individual drive of machinery, coupled with severe requirements in speed variation, has thrown increased business upon controller builders. So far as motor control goes, the situation seems well in hand, however. The development of motor business from the dull period of a year or more ago to the present excellent volume has been very gradual, and it is highly creditable to control manufacturers that they are still able to make reasonably good deliveries on standard outfits, keeping well within the delivery promises of the motor builders. The marketing of modern control equipment is greatly influenced by the engineering requirements of great industries into which the variable-speed motor drive is making new records of efficiency. In the printing-press and paper-making fields, especially, the refinements of control demanded have opened new problems to the manufacturing engineer, and the solution of these on a shop rather than on a laboratory basis has resulted in a quickening of the market throughout these industries. Other developing industries are interactive with controller production. The steady advance of electric vehicle and industrial electric truck applications, the requirements of control in electric heating apparatus designed for chemical and physical laboratory service and the demands of a vacuum-tube set regulation by rheostatic control in radio work all spell increased orders for makers of control apparatus. One house alone has sold more than 500,000 small rheostats for radio service since last summer.

## Sales Service a Real Factor in Industrial Truck Situation

FIRM prices and a tendency toward longer deliveries mark the industrial truck situation, but as yet it is not difficult to meet reasonable requirements with satisfactory promptness. In this class of work 100 per cent service between the factory and the field representative has an immediate bearing upon the success of sales efforts. Delays in furnishing quotations and information to prospective buyers are injurious because of the detailed investigations which must precede contract awards in the great majority of cases. Poor mail service has hampered this business not a little in the past winter, but despite various handicaps sales have been made in increasing numbers and the outlook for a good year is excellent.

## Lamp Sales Reflect Growth of Industry

SUPERSEASONAL lamp sales are reported from manufacturers and distributors, and if production facilities had not been developed many months ago in far-sighted anticipation of the growing demand, a shortage could scarcely have been escaped during the past winter. The extension of electrical service grows like a rolling snowball in practically all parts of the country; replacement orders continue to mount higher each year, and the increased attention now paid to decorative lamp

## Comparative Prices of Station Supplies

| | Current Price | Four Weeks Ago | One Year Ago |
|---|---|---|---|
| Soft steel bars, per lb. | $0.0326 | $0.0322 | $0.0229 |
| Cold finished shafting, per lb. | 0.0406 | 0.0406 | 0.035 |
| Brass rods, per lb. | 0.1913 | 0.1870 | 0.1533 |
| Solder (half and half), per lb. | 0.30 | 0.2833 | 0.20 |
| Cotton waste, per lb. | 0.1231 | 0.1181 | 0.104 |
| Washers, cast iron (¾-in.), per 100 lb. | 4.66 | 4.33 | 3.83 |
| Emery, disks, cloth, No. 1, 6-in. diameter, per 100 | 2.96 | 2.96 | 3.11 |
| Machine oil, per gal. | 0.349 | 0.349 | 0.40 |
| Belting, leather, medium, off list | 42% | 49% | 48½% |
| Machine bolts, up to 1-in. x 30-in., off list | 44½% | 51½% | 64½% |

design and the enormous expansion of utility lamp applications in commerce, industry and the home, in the automobile field and in science tends to swell the totals of recurrent sales. Lamp prices are firm, with few if any recent changes; raw materials are well in hand at the factories, and labor-saving machinery is constantly being more effectively adapted to production conditions. While it is true that the winter season brings the peak of consumption to its annual maximum in this branch of the electrical industry, the highly organized sales efforts of the lamp maker are so carefully planned and carried out through the year, with remarkably able advance gaging of demand, that requirements are met with little outward evidence of wear and tear upon producers and distributors.

### Atlanta Shows Tendency to Increase Cash Discounts

COLLECTIONS for the past thirty days show improvement over the prior month, with a tendency toward an increase in the number of cash discounts taken. Credit men, as a rule, are extending a more liberal line of credit than has been the case for some time past, but are more cautious than during the last period of good business. A number of the jobbers report an increasing amount of cash sales, with money easy in middle and south Georgia and Florida. There has been voiced in isolated instances the fear that easy money will cause firms to overreach, with a resultant reaction in the late fall. Volume of business is on the increase, as is illustrated by the debits to personal accounts for twenty-five southeastern cities for March, the increase amounting to $30,000,000 over February.

## The Metal Market

A dull week with lower prices is reported. Rarely does it happen that demand for all metals should be so poor at one time. As consumption continues excellent in almost all lines, it is to be inferred that metal buyers have heeded the warnings of a possible inflation and the lessons learned in 1920 and are reducing their stocks and orders for future supplies of raw materials to the lowest possible amount consistent with safety.

NEW YORK METAL MARKET PRICES

| | April 18, 1923 Cents per Pound | April 25, 1923 Cents per Pound |
|---|---|---|
| Copper, Electrolytic | 17.00–17.25 | 17.00 |
| Lead, Am. S. & R. price | 8.25 | 8.25 |
| Antimony | 8.75 | 8.37½ |
| Nickel, ingot | 28.00–30.00 | 28.00 to 30.00 |
| Zinc, spot | 7.37½ | 7.37½ |
| Tin, Straits | 47 50 | 46.62½ |
| Aluminum, 98 to 99 per cent. | 26.00–27.00 | 26.00 |

**Electrical Slate Sales in 1922.**—Sales of electrical slate in the United States during 1922 amounted to $976,022, according to the Geological Survey in a report just made to the Department of the Interior. Quantity sold amounted to 1,329,500 sq.ft.

# Activities of the Trade

Devoted to News of the Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

### Copeland Products, Inc., Will Make Refrigerating Units

Copeland Products, Inc., has been organized as a Delaware corporation for manufacturing electric household refrigerating units, with factories in Flint, Mich. Capitalization consists of 200,000 shares of no-par-value stock, 100,000 shares of which have been subscribed by Flint and Detroit people. Development work in connection with production has been in progress for a year, the work having been done by the Electricold Corporation, which the new company succeeds. Work will commence during the summer on a new building, but for the time being temporary facilities are being used. E. J. Copeland is president of the company.

### Westinghouse Electric Entertains McGraw-Hill Editors

Realizing the better service to their industries that technical editors can render by closer knowledge of manufacturers' problems and accomplishments, the Westinghouse Electric & Manufacturing Company entertained a group of McGraw-Hill editors at its East Pittsburgh works this week. The trip was specially arranged to see the company's engineers who were handling the work in which the editors were most interested. Special shop visits were also arranged so that they could see special equipment in course of construction. A luncheon and a dinner afforded still further opportunity for the editors and the company engineers to get acquainted and discuss problems of mutual interest.

### Cook Electric Will Manufacture in Chicago

The Cook Electric Company, 900 West Van Buren Street, Chicago, has sold its Zion plant to Wilbur Glenn Voliva and will move about May 1 to its recently purchased new plant at 2700 Southport Avenue, Chicago. This new building cost $150,000 and will contain the general offices and factory of the company. The floor area is 40,000 sq.ft., being equivalent to its floor capacity at Zion City. There is also about 32,000 additional square feet of vacant land.

President G. R. Folds stated that this change was made in order to obtain better unity of action since there has been considerable lost motion in manufacturing at Zion City and assembling in Chicago. The new arrangement, however, will afford better manufacturing facilities in the production of telephones and telephone equipment. About 1,000 sq.ft. of floor area will be added at the present time in the form of a tool vault. No change in the management occurred and the officers still remain: G. R. Folds, president; A. D. Edwards, vice-president; E. R. King, secretary-treasurer.

### Consolidated Supply Firms Move to New Quarters

The Fobes Supply Company, 523 Mission Street, San Francisco, wholesale electrical supplies, on May 1, will be consolidated with the Electric Railway & Manufacturers' Supply Company under the firm name of the Fobes Supply Company. On the same date the new company will move to its new building at 260 Fifth Street. Officials of the firm will be: F. N. Averill, president; R. J. Holtermann, general manager; B. S. Manuel, sales manager; R. F. McDonald, assistant sales manager, and E. J. Duggan, purchasing agent.

### Electric Machinery Firm Moves

The Electric Machinery Manufacturing Company, Minneapolis, has changed its Chicago office from the Fisher Building to 1141 Monadnock Building, 53 West Jackson Boulevard. This office will now be in charge of Will H. Peterson, district manager, with Howard B. Johnson as assistant district manager.

### Allis Chalmers 1922 Profits Amounted to $2,208,549

The net profits of the Allis Chalmers Manufacturing Company, Milwaukee, for 1922 were slightly lower than that of the year before, while the unfilled orders on hand at the close of 1922 were in excess of those of 1921, as shown in the annual report of the company just made public.

The net profit of the company for 1922 was $2,208,550, while in 1921 the net profit was reported as $2,215,468. Unfilled orders on hand at the close of the year amounted to $8,215,545 as compared with $7,300,574 in 1921.

In his report to the stockholders, President Otto H. Falk said that while the amount of unfilled orders on hand on Dec. 31, 1922, was not largely in excess of the year before, the prospect for 1923 is favorable and the orders for the present year will show a "substantial increase over the preceding year."

Inventories were priced at cost or market, whichever was lower. This resulted in a write-off of $333,903. The total value of all inventories on Dec. 31, 1922, was $10,009,030 as against

$12,504,188 the year before. During the year the holders of preferred stock increased from 3,295 to 3,591 and holders of common stock decreased from 3,833 to 3,715.

## Hubbard & Company Sales Appointment

Warren M. Heim, who has been district manager of Hubbard & Company, Pittsburgh, with headquarters at 30 Church Street, New York City, for the past two years, has recently been made assistant manager of the electrical materials department of this company in charge of sales, service and production.

Mr. Heim has been associated with the industry since 1910, when, after his graduation from the Pennsylvania State University, he joined the Long Island Lighting Company as construction engineer.

## Cutler-Hammer Arranges Texas and Oklahoma Agency

The Cutler-Hammer Manufacturing Company, Milwaukee, has made an agency arrangement with O. T. Jenkins, 1002 Pacific Avenue, Dallas, Tex., effective March 1, 1923, covering the sale of wiring devices, radio apparatus and standard industrial heating apparatus, such as soldering irons, space heaters, confectioners' appliances, water heaters, etc. The territory covered is Texas and Oklahoma.

## General Electric Completes Oakland Factory

To meet the increasing demands for electrical equipment in the West the General Electric Company has just completed and is now occupying its new $250,000 factory in Oakland, Cal. The building is of steel and brick construction and contains 45,000 sq.ft. of floor space. The factory will be used as an assembling plant and for the manufacture of transformers, switchboards and other equipment and will contain a service shop as well.

The lighting of the building received special consideration and is attracting attention because of the high intensity of illumination and the even distribution of light in all parts of the building.

An interesting feature of the operations that will be conducted in the plant is the instrument laboratory, in which will be maintained many electrical standards secured from Washington. About 150 men will be employed when the plant is in normal operation.

**The Inland Glass Company**, Chicago, incorporated for $750,000, to manufacture illuminating glassware, has begun operation on its new $500,000 plant. The project was promoted by J. B. Weaver, formerly vice-president of the Pullman Company, who is president of the new company, and H. Pickett Whithers, formerly of Marshall Field, Glore, Ward & Company, who is secretary-treasurer of the new company.

**The Gardner Electric Manufacturing Company**, Emeryville, Cal., recently incorporated with a capital stock of $50,000, has completed the erection of its building and the installation of machinery and is now on an operating basis. W. C. Gardner heads the company.

**The Kent Oil Burner Corporation**, 111 Broadway, New York City, has been organized to manufacture oil-burning equipment. Arrangements will be made to have the company's products manufactured by an outside plant, the corporation simply engaging in marketing and selling. This arrangement, however, is only temporary. and later the company expects to build a plant of its own. T. F. Kemp is president of the company.

**The Blaw-Knox Company**, Pittsburgh, manufacturer of steel transmission towers, reports the largest amount of unfilled business on its books in the history of the company. The company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock and 2 per cent on the common stock, both payable May 1, to stockholders of record of April 20.

**The Foxboro Company**, Foxboro, Mass., manufacturer of electrical recording instruments, plans the erection of a four-story addition, 60 ft. x 160 ft.

**The Pacific Electric Manufacturing Company**, San Francisco, has leased additional floor space of approximately 15,000 sq.ft. in a building adjoining its present quarters. The new space will enable it to increase its manufacturing facilities so as to take care of the large volume of new business which the company is receiving.

**The National Carbon Company, Inc.**, is removing its "Ever-Ready" plant from Long Island City, New York, to Cleveland, where, it is stated, the company's production of flashlights and radio batteries will be quadrupled. The battery department will occupy a three-story building, erected during the war, which has been equipped for the new department. Among the executives who will be transferred from the Long Island plant will be A. V. Wilker, general superintendent; Charles Randall and W. H. Hines, in charge of production.

**The Walker Vehicle Company**, State and Eighty-seventh Streets, Chicago, manufacturer of commercial automobiles, has tentative plans for a new branch plant at New Orleans, to be used for electric trucks.

**The Peterson Storage Battery Company**, 323 South Lafayette Street, South Bend, Ind., is planning the erection of a new one-story factory, to cost approximately $30,000.

**The Electric Power Equipment Corporation** has just completed its new plant at 412 North Eighteenth Street, Philadelphia, where 30,000 sq.ft. of floor space will be used for manufacturing purposes. The former address of the company was at Thirteenth and Wood Streets.

**The Mercury Manufacturing Company**, manufacturer of storage battery trucks, 4118 South Halsted Street, Chicago, has let contracts for a one-story addition to its plant, to cost $40,000.

**The Metal Ware Corporation**, Two Rivers, Wis., which has increased its capital from $300,000 to $350,000, is taking over the manufacture of the electrical appliance line of the Harvey Electric Company, Chicago. D. C. Hughes, production manager of the Harvey Company, has been transferred to Two Rivers to supervise the department, in which electric irons, toasters and other electric products will be manufactured. C. F. Kirst is president of the Two Rivers Company.

**The Armature Rewinding Company**, 3305 Washington Avenue, St. Louis, has awarded a contract for a two-story plant, 50 ft. x 125 ft., at 605 North Leonard Avenue, for the manufacture and repair of electrical machinery, estimated to cost $50,000.

**The Quality Electric Company**, Los Angeles, manufacturer of electrical products, has plans for a new one-story factory, 40 ft. x 175 ft., at 812 San Pedro Street.

**The Marko Storage Battery Company**, 102 Jefferson Avenue, Brooklyn, N. Y., will soon take bids for the erection of a new two-story addition, 70 ft. x 90 ft., for considerable increase in capacity. It will cost approximately $50,000.

**Landers, Frary & Clark, Inc.**, New Britain, Conn., manufacturers of electric heating and cooking appliances, have completed plans for the erection of a three-story addition to their plant, to cost approximately $70,000. The company purposes to remove its present plant at Newark, N. J., to the main factory.

**The Connecticut Telephone & Electric Company, Britannia Company**, Britannia Street, Meriden, Conn., has completed plans and will take bids at once for the erection of a large addition to its plant.

**The H. T. Electric Service Company**, Indianapolis, has plans under way for the erection of a new two-story plant, 55 ft. x 195 ft., on North Capitol Avenue, estimated to cost $30,000.

**The Esterline-Angus Company**, 227 East South Street, Indianapolis, manufacturer of electrical equipment, is planning for the erection of a two-story plant at Blackford and New York Streets, to cost about $70,000. The present factory will be removed to the new location as soon as the structure is ready.

**The William A. Baehr Organization** has changed its Chicago office from the People's Gas Building to the Illinois Merchants Bank Building, 230 South Clark Street.

**The Louis Allis Company**, Milwaukee, manufacturer of motors, announces the establishment of its Alabama agency, the Commercial Electric Sales Company, 1322 Empire Building, Birmingham.

## Foreign Trade Notes

THE YATAWA (JAPAN) IRON WORKS TO BE EQUIPPED FOR ELECTRICAL OPERATION.—Definite plans are now being prepared, *Commerce Reports* states, for the general electrification of the Yatawa Iron Works of the Japanese government, which will involve an expenditure of 18,000,000 yen ($9,000,000) and cover a period of three years. The work will include the installation of electric cranes, conveyors, motors, etc.

ELECTRIC RANGES IN SOUTH AFRICA.—The Town Council of Durban, South Africa, according to *Commerce Reports*, is looking into a scheme for renting electric ranges to consumers of electricity. Electric heating devices are already freely used.

EXTENSION TO ELECTRIC PLANT IN YUNNANFU, CHINA, PROPOSED.—Plans are under consideration for extensions to the electric power plant in Yunnanfu, China, *Commerce Reports* states, which will include the installation of two 420-hp. water turbines, two generators, one of 350 kva. and one of 400 kva. capacity; switchboard equipment and accessories.

HYDRO-ELECTRIC SCHEME FOR CHINA.—The Foochow Electricity Company is planning to build a hydro-electric plant at the waterfalls between Shipping and Lungting, in the Kutien district, China.

NEW COMPANY FORMED TO SUPPLY ELECTRICITY IN MINAS GERAES, BRAZIL.—A company is being organized with a capital stock of 400,000 milreis (one milreis = $0.5462 at normal exchange), according to *Commerce Reports*, to supply electricity for lighting and power purposes in two cities in the State of Minas Geraes.

ELECTRICITY FOR ILOILO, PHILIPPINE ISLANDS.—Electricity for the city of Iloilo, Philippine Islands, *Commerce Reports* states, is to be provided by a new plant which is being installed by the Philippines Engineering Company. Plans are also being prepared for establishing an electric railway system, to cost about $500,000.

THE SUTLEJ VALLEY (INDIA) HYDRO-ELECTRIC PROJECT ABANDONED.—The Punjab Electricity Board is understood to have abandoned the Sutlej Valley hydro-electric project. The government proposes to concentrate on the Uhl River scheme in the Mandi State.

PROPOSED ELECTRIC PLANT FOR DURBAN, SOUTH AFRICA.—Application has been made to the Union government by the Town Council of Durban for permission to build a power station at Congella, under the new electricity act. A conference has been suggested by the government between the representatives of the Durban municipality, the Electricity Supply Commissioners (a body to be appointed) and the South African Railway Administration.

## Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired in Turin, Italy (No. 6,127), for electrical novelties, etc.

An agency is desired in Paris, France (No. 6,137), for telephone and telegraph apparatus, including wireless.

An agency is desired in London, England (No. 6,146), for small motors, vacuum cleaners, washing machines, electric heating appliances, electric refrigerators, electric table fountains and similar specialties.

Purchase and agency are desired in Shanghai, China (No. 6,147), for rubber jars for storage batteries, 6-volt and 12-volt, etc.

An agency is desired in London, Canada (No. 6,148), for electrical specialties, lighting fixtures and wiring supplies.

An agency is desired in Melbourne, Australia (No. 6,168), for electrical supplies, automobile accessories and specialties and tools of these trades.

Purchase is desired in England (No. 6,171) for plumbing, heating and lighting equipment, etc.

An exclusive agency is desired in Johannesburg, South Africa (No. 6,149), for supplies for engineering and mechanical and kindred industries, such as electric lamps, grinders and machine tools.

PROPOSED HYDRO-ELECTRIC DEVELOPMENT IN NEWFOUNDLAND.—A scheme has been approved by the advisory committee under the trade facilities act which aims to develop hydro-electricity to operate pulp and paper mills. It is proposed to utilize the water power of Deer Lake, from which it is estimated that between 230,000 hp. and 240,000 hp. could be developed. The plans provide for an initial plant of 100,000 hp. It is proposed to use electric boilers on a large scale for producing steam necessary for the production of pulp and paper. A sum of £4,000,000 will be guaranteed jointly by the British and Newfoundland governments. The hydraulic work will be in charge of W. G. Armstrong, Whitworth & Company, Ltd., who are interested in the project.

## New Apparatus and Publications

DRY BATTERIES.—The National Carbon Company, Inc., Thompson Avenue and Orton Street, Long Island City, has added two new types to its steel case Columbia "Hot Shot" line of batteries.

FUSES.—Bulletin No. 200 issued by Schweitzer & Conrad, Inc., 4,435 Ravenswood Avenue, Chicago, covers the "S & C" extra high-potential fuse and other types of the "S & C" high-voltage fuses.

ELECTRIC DRILLS AND REAMERS.—The Hisey-Wolf Machine Company, Cincinnati, has issued bulletin No. 106, covering its "Hisey" portable electric drills and reamers.

INDUCTION VOLTAGE REGULATORS.—The General Electric Company, Schenectady, N. Y., has issued thirty-two leaflets giving construction details of its induction voltage regulators.

MOTOR.—Bulletin No. 132 issued by the Wagner Electric Corporation, St. Louis, describes and illustrates its "Pow-R-ful" motor.

BLUEPRINTING MACHINE.—The C. F. Pease Company, 813 North Franklin Street, Chicago, has developed the "Pease" sheet drier, which is designed for drying blue prints, negative prints and photographic prints.

WATER-TUBE BOILERS.—Bulletin No. 2 issued by the A. D. Granger Company, New York City, describes and illustrates the "Oswego" internally fired water-tube boiler.

ATTACHMENT FOR CONTROL SWITCHES.—A full automatic attachment that can be added to any type "CS" circuit-breaker control switch has been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania.

FUSE BOX.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is distributing leaflet No. 20,005, covering its type "OD" safety-first fuse box for use on circuits up to 100 amp. and 7,500 volts.

METERS.—The American Electrical Instrument Corporation, 147 Palisade Avenue, Union Hill, N. J., is distributing bulletins Nos. L-104, L-105 and L-107, entitled "'Aimco' Sliding Contact Tube Rheostat," "'Aimco' Vibrating Reed Tachometers" and "'Aimco' Vibrating Reed Frequency Meters" respectively.

PROTECTIVE RELAYS.—Bulletin No. 417-2 issued by the Condit Electrical Manufacturing Company, South Boston, Mass., covers its protective relays and accessories for electrically operating switchgear.

## New Incorporations

THE PUBLIC SERVICE ELECTRIC POWER CORPORATION OF NEW JERSEY, Newark, N. J., has been chartered to construct an electric superpower station on the Kearney Meadows. The officers are: Richard E. Danforth, president; Henry D. Whitcomb, vice-president; William H. Feller, secretary, and Frederick A. Neils, treasurer.

THE THORSBY (ALA.) LIGHT & DEVELOPMENT COMPANY has been chartered with a capital stock of $10,000 by A. E. Reagan, C. E. Lucas and Felix Eiland.

THE MANN-FINK ELECTRIC COMPANY, Tacoma Park, D. C., has been incorporated by Leroy S. Mann, G. Ernest Fink and others. The company is capitalized at $10,000.

# Construction News

**Projects, Plans, Bids and Contracts; Contemplated or Under Way**

## New England States

AUGUSTA, ME.—The Maine Central Power Company has issued $600,000 in bonds, part of the proceeds to be used for extensions and improvements in its system.

RUMFORD, ME.—The Oxford Paper Company will install electric power equipment in connection with extensions, to cost about $300,000.

GORHAM, N. H.—The Twin State Gas & Electric Company, 160 State Street, Boston, has completed plans for a hydro-electric power plant to cost $275,000, for which a site has been acquired. R. J. Andrus is engineer.

LUNENBERG, VT.—The electric plant and system of the Lunenberg Manufacturing Company, which furnishes local commercial service, has been acquired by the Twin State Gas & Electric Company, 160 State Street, Boston. A transmission line will be erected to Lunenberg and extensions and improvements will be made to the local system.

LEE, MASS.—Plans, it is reported, are under consideration by the Smith Paper Company for the construction of an electric plant on the Housatonic River, between its Niagara and Centennial Mills.

WEYMOUTH, MASS.—The Edison Electric Illuminating Company, Boston, has awarded a general contract to Stone & Webster, Inc., 147 Milk Street, Boston, for the construction of the first unit of a steam-operated power plant, to cost about $5,000,000, with equipment.

NEW HAVEN, CONN.—The United Illuminating Company will build a transformer station at 34 Wallace Street.

## Middle Atlantic States

BUFFALO, N. Y.—Bids will be received by the Board of Education, Telephone Building, until May 2 for transformers, switches and other electrical apparatus for the vocational school on Elmwood Avenue.

NEW YORK, N. Y.—Bids will be received by the New York Central Railroad Company until May 4 for one 2,000-kw. rotary converter and one 2,100-kva. transformer, with switchboard and auxiliary apparatus. (Serial contract No. 13, 1923.) C. S. White, Room 344, 466 Lexington Avenue, is purchasing agent.

NEW YORK, N. Y.—Electric power equipment for general service, ice-manufacturing and refrigerating departments will be installed in the market building to be erected by the Department of Public Markets, Room 2337, Municipal Building, at Cromwell Avenue and the Harlem River, to cost about $6,000,000.

NEW YORK, N. Y.—Electric power equipment will be installed in the baking plant to be built by Cushman's Sons, Inc., 461 West 125th Street, on Lawrence Street, to cost about $150,000. L. S. Beardsley, 116 West Thirty-ninth Street, is architect.

SYRACUSE, N. Y.—The Syracuse Lighting Company contemplates extensions and improvements to its system during the next eighteen months, to cost about $4,000,000.

UTICA, N. Y.—The Utica Gas & Electric Company will erect a 110,000-volt transmission line to connect with the system of the Northern New York Utilities, Inc., Watertown, from which it will purchase hydro-electric power up to 25,000 kw., the service to begin in June. F. M. Tait is president and general manager.

FRANKLINVILLE, N. J.—Theodore Blank, Porchtown, plans to build a hydro-electric plant on lake property at Porchtown and Malaga. A transmission system will be erected to furnish commercial service at Franklinville and vicinity.

ALLENTOWN, PA.—The Amerag Corporation plans to build a power house in connection with its proposed plant at Greenawalds, a suburb, to cost about $500,000.

BROOKVILLE, PA.—The Jefferson Electric Company has been granted permission to acquire eight electric power companies

operating in this section and will merge the systems. Plans are under way for extensions and improvements.

EDGELY, PA.—The Margargee Paper Company, Modena, is preparing plans for a 4,000 kw. steam-operated electric generating plant in connection with its proposed new local mills. The cost of the project is estimated at $600,000.

HANOVER, PA.—The Metropolitan Edison Company, Reading, has acquired the properties of the Hanover Power Company and the Gettysburg (Pa.) Electric Company. The systems will be consolidated and extensions made.

HAWLEY, PA.—The Pennsylvania Power & Light Company, Allentown, plans to build a large local generating plant to furnish service to a number of distributing companies, now being organized as subsidiaries, to operate in parts of Carbon, Luzerne, Wayne, Lackawanna, Munroe and Pike Counties.

PHILADELPHIA, PA. — The Philadelphia & Reading Railroad Company, Reading Terminal, will build a power house at its proposed grain elevator (to cost about $3,000,000) in the Port Richmond section.

WILLIAMSPORT, PA. — The Keystone Glue Company is preparing plans for a power plant at its factory, to cost $200,000, including machinery.

ELKTON, MD.—The Northern Maryland Electric Company, Baltimore, plans extensions in its hydro-electric plant, in the vicinity of McCall's Ferry, on the Susquehanna River, increasing the capacity to 410,000 hp. The cost is estimated at $1,000,000.

LAUREL, MD. — The Annapolis Public Utilities Company has acquired the local municipal electric plant and will make extensions and improvements, including a transmission line.

MASON CITY, W. VA.—The Hutchison Coal Company contemplates rebuilding its power house, recently damaged by fire, causing a loss of about $40,000.

NORFOLK, VA. — The Norfolk Sugar Refining Company, recently organized, plans to build a power house in connection with a local sugar refinery, to cost about $750,000. J. B. Morgan and J. H. Caldwell, both of Norfolk, are interested in the company.

WASHINGTON, D. C.—Bids will be received by the Chief Signal Officer, United States Army, until May 3, for 2,093 connecting switchboard cords (Proposal 13488-A-2ACP).

## North Central States

TOLEDO, OHIO.—The Ajax Rubber Company, Trenton, N. J., plans to build a substation at its proposed local tire-manufacturing plant. The cost of the work is estimated at $200,000.

TOLEDO, OHIO. — The Toledo Edison Company is installing an additional 30,000-kw. turbo-generator unit at its Acme station. J. F. O'Connor is manager of the electric department.

TOLEDO, OHIO. — The Toledo Edison Company has issued $1,500,000 in capital stock, part of the proceeds to be used for extensions and improvements.

PINEVILLE, KY.—The Kentucky Utilities Company plans to erect a local power plant, to cost about $100,000, for which a site has been acquired.

CHANDLER, IND.—The Boonville (Ind.) Electric Light & Power Company is erecting a transmission line to Chandler (6 miles long) to supply electricity here and to the farmers and the coal mines along the route. K. H. Weyerbacher is manager.

INDIANAPOLIS, IND.—Plans are under way for equipping the plant of the Lavelle Foundry Company, Michigan Street, for electrical operation throughout.

LAFAYETTE, IND.—A power plant will be built at the Indiana State Soldiers' Home, for which bids will be called at once. W. M. Louden is commandant.

MARION, IND.—The Upland Flint Glass Company will install electric power equipment in connection with the rebuilding of its local plant, recently damaged by fire, causing a loss of about $100,000.

BAYFIELD, WIS.—Plans are under consideration to purchase electricity to operate the municipal system from a hydro-electric plant under construction at Port Wing, Orienta Falls, and to extend the lines to La Pointe and Madelaine Island, a distance of 3 miles, by a submarine cable. L. W. Barnes, is superintendent.

BELLEVILLE, WIS. — The Belleville Electric Light & Power Company contemplates extensions to its light and power lines, to cost about $10,000.

JOHNSON CREEK, WIS.—The installation of a new ornamental lighting system is under consideration. It is proposed to replace the three-lamp clusters with single-lamp posts.

OCONTO FALLS, WIS.—The Falls Manufacturing Company contemplates the construction of a power house in connection with a new paper mill, to cost about $160,000.

OSHKOSH, WIS.—The Wisconsin Public Service Corporation is planning to erect a 6,600-volt transmission line from Oshkosh to Pickett, which will also supply electricity to Fisk and Elo.

ST. CLOUD, MINN.—Expansion of the terminals of the Great Northern Railway Company at St. Cloud, to cost about $500,000, include a power house, roundhouse, machine shop, etc.

BROOKFIELD, MO.—At an election to be held April 30 the proposal to issue $95,000 in bonds to construct a municipal electric light plant will be submitted to the voters.

ST. JOSEPH, MO.—Plans for a proposed local cement-manufacturing plant to be erected by Claude H. Light, Garden Grove, Iowa, and associates, to cost about $250,000, include a power plant.

MERRIMAN, NEB. — Plans are under way to extend the electric transmission lines of the Cornell Hydro-Electric Company at Valentine to Gordon and Merriman.

WICHITA, KAN. — The Kansas Milling Company has authorized plans for a one-story power plant in connection with a new mill. The Benham Engineering Company, Gumbel Building, Kansas City, Mo., is consulting engineer.

## Southern States

ANDREWS, N. C.—Bonds to the amount of $350,000 have been authorized by the Board of Aldermen for the construction of a hydro-electric plant on the Hiawassee River, to develop about 1,500 hp. The Ludlow Engineers, Inc., Engineers, Winston-Salem, will have charge of the work.

AINSLIE, GA.—The Southeastern Portland Cement Company, Macon, recently organized, plans to erect a power house at its proposed local cement-manufacturing plant, to cost about $500,000. W. Jordon Massee is president.

AMERICUS, GA. — The South Georgia Public Service Company has purchased the system of the Americus Lighting Company. A transmission line will be erected from Albany, Ga.

DAYTONA, FLA.—The Daytona Public Service Company plans to install additional equipment in its plant.

GARY, FLA.—The Tampa Glass & Bottle Manufacturing Company, Tampa, plans to build a power house at its proposed new local plant.

MIAMI BEACH, FLA. — An improved street-lighting system will be installed to cost about $20,000, for which bonds have been voted.

BELLS, TENN.—The Bells Light & Water Company contemplates installing an ice plant in connection with its electric plant. A. T. Chronister is manager.

KNOXVILLE, TENN.—The Knoxville P. & M. Mortar Company plans to build a power house in connection with its proposed local works for cement plaster, fireclay, etc. W. B. Townsend is the president of the company.

BIRMINGHAM, ALA. — The Alabama Power Company contemplates building an additional hydro-electric power plant on the Warrior River, to cost about $1,000,000.

MONTGOMERY, ALA. — The Alabama Power Company has issued $4,000,000 in bonds, part of the proceeds to be used to acquire the properties of the Montgomery Light & Water Power Company, Montgomery Light & Traction Company, Power Transmission Company and the People's Electric Light & Ice Company, and for proposed extensions and improvements to the systems.

CANTON, MISS.—Bonds have been voted for extensions and improvements in the municipal lighting system and waterworks, to cost about $75,000.

POPLARVILLE, MISS. — The Southern Power & Manufacturing Company, New Orleans, plans extensions to the local electric plant, lately acquired. It is also proposed to install an ice-manufacturing and refrigerating plant.

GIBSLAND, LA.—A bond issue of $50,000 has been authorized for the installation of an electric system and improvements to waterworks.

SHREVEPORT, LA. — The Red River Refining Company plans to build a power house in connection with a new local oil-refining plant, to cost about $500,000.

ENID, OKLA.—Plans for the proposed terminal grain elevator, to be erected by the Enid Terminal Elevator Association, at a cost of about $500,000, include a power house.

MULDROW, OKLA.—The municipal electric plant has been acquired by the Oklahoma Gas & Electric Company, which will furnish service from a new transmission line. The local plant will be remodeled for a substation.

EDGEWOOD, TEX.—Bonds to the amount of $15,000 have been voted to establish a municipal electric light plant.

GRANBURY, TEX.—Bonds to the amount of $28,000 have been voted for the installation of an electric light and power system.

HULL, TEX.—The Gulf Production Company will build an electric power plant, with transmission lines for power service, at its oil properties, to cost about $1,000,000.

## Pacific and Mountain States

GRANITE FALLS, WASH.—The Puget Sound Light & Power Company, Seattle, plans to extend its transmission line from Granite Falls to Hartford.

MARBLE, WASH.—The Stevens County Power & Light Company will build a transmission line from Colville, through Echo Valley and Lake City, to Marble.

SEATTLE, WASH.—The City Lighting Department is considering plans for the installation of new lighting units on streets in the main business district.

TACOMA, WASH.—The Tacoma Harbor Lumber Company, recently organized, will build a power house at its proposed local mill. The cost of the project is estimated at $100,000.

VANCOUVER, WASH. — Contract has been awarded by the Columbia River Paper Mills Corporation to the Gilpin Construction Company, Portland, Ore., for the first unit of its proposed work,s to cost about $200,000. A power plant and machine shop will be built later. The entire plant, including other units, will cost about $1,200,000.

CORNING, CAL.—A hydro-electric development by utilizing water power secured from Trinity River in Trinity County is under consideration by W. H. Samson, Corning, and associates. The plans call for a development of 285,000 hp. and the use of the water later for irrigating 400,000 acres of land in Glenn, Colusa, Yolo and Tehama Counties. Two hydro-electric plants are planned, to cost about $30,000,000.

LONG BEACH, CAL. — Bonds to the amount of $80,000 have been voted for the installation of an electric fire-alarm system.

LOS ANGELES, CAL.—Bids will be received by the County Board of Supervisors until May 7 for furnishing and installing one steam-turbine-driven electric generator at the County Hospital.

LOS ANGELES, CAL.—Electric power equipment will be installed in the two-story ice-manufacturing and cold-storage plant to be erected by the Los Angeles Ice & Cold Storage Company on Mesquit Street, to cost about $50,000. John E. Kunst, 820 Higgins Building, is architect.

OAKLAND, CAL. — Bids will soon be called for the installation of an ornamental lighting system in the Lake Merritt district. Howard Gilkey is engineer.

ROSEVILLE, CAL.—Plans are under consideration for the installation of an ornamental lighting system on Church and Lincoln Streets.

SANTA ANA, CAL.—Plans are being prepared for the installation of an electric fire-alarm system, to cost $25,000, for which bonds have been voted.

WINKLEMAN, ARIZ. — The Arizona Portland Cement Company, Phoenix, will build a power house at its proposed cement-manufacturing plant. The cost of the project is estimated at $750,000.

## Canada

NELSON, B. C. — The Street Railway, Light and Power Departments contemplate extensions of transmission line (14 miles) to supply electricity for lighting and mines in the rural districts. G. T. McGuire is general superintendent.

ROSSLAND, B. C.—Plans to increase its hydro-electric developments at Bonnington

Falls on Kootenay River from 30,000 hp. to 60,000 hp. is under consideration by the West Kootenay Power & Light Company.

ST. JOHN, N. B.—The New Brunswick Electric Power Commission contemplates the erection of approximately 30 miles of additional low-tension rural feeder lines. G. A. Vandervoort is the general superintendent.

PARRY SOUND, ONT.—The Public Utilities Commission contemplates building two storage dams and also the installation of a 1,200-kva. generating unit and extensions to the distribution system. As yet nothing definite has been decided upon. W. F. Lockard is manager.

ESTEVAN, SASK.—The installation of a 300-kw. steam-engine-driven generator, three-phase, 60-cycle, 2,300 volts, and the erection of 1 mile of high-tension transmission line is under consideration by the Municipal Electric Light Department. J. B. Hamilton is manager.

MELVILLE, SASK.—The Light and Power Department is considering the installation of a lignite coal producers and tar-extracting machinery. James Anderson is superintendent.

# Electrical Patents

**Announced by U. S. Patent Office**

(Issued March 27, 1923)

1,450,156. Electrolytic Apparatus; J. N. Smith, Toronto, Ont., Canada. App. filed April 7, 1921. Electrolysis of saline solutions, production of oxygen and hydrogen or electrodeposition of metals.

(Issued April 3, 1923)

1,450,172. Swivel-Plug Connector; E. Dewald, Sr., Cincinnati, Ohio. App. filed March 8, 1920.

1,450,246. Piezo Electric Resonator; W. G. Cady, Middletown, Conn. App. filed Jan. 28, 1920.

1,450,253. Switching Device; H. A. Douglas, Bronson, Mich. App. filed Aug. 15, 1918. Switch for lamp socket such as is used on automobile instrument board.

1,450,254. Balancing Arrangement for Multiplex Carrier Circuits; L. Espenschied, Hollis, N. Y. App. filed Sept. 26, 1919. Balancing transmission circuit for several frequencies.

1,450,265. Hot-Cathode Tube; J. Slepian, Wilkinsburg, Pa. App. filed April 18, 1919. Used for rectification and in detector-bulb work.

1,450,275. Wireless Amplifier; C. T. Alcutt, Pittsburgh, Pa. App. filed Dec. 31, 1918. Cathode of a vacuum-tube amplifier, an electrode opposite cathode, a second electrode in plane parallel to cathode, and grid between the two electrodes.

1,450,276. Trolley Crossing; R. E. Andrew, Philadelphia, Pa. App. filed Feb. 21, 1922. Insures smooth passage of trolley wheel.

1,450,277. Waffle and Hot-Cake Iron; E. N. Brown and A. M. Lambert, San Francisco, Cal. App. filed Jan. 31, 1922. Reversible plates heated by variable-resistance elements.

1,450,294. Welding Tool; J. Jerry, Milwaukee, Wis. App. filed Dec. 29, 1920. For holding electrode or fusing strip.

1,450,305. Telephone Signaling System; W. A. Rhodes, New York, N. Y. App. filed Oct. 25, 1919. Means for providing "disconnect" and "busy" signals for telephone systems.

1,450,310. Lining for Conduit Outlet Boxes; W. M. Silliman, Syracuse, N. Y. App. filed Oct. 17, 1918. Lining or trim inserted which separates box into compartment.

1,450,321. Party-Line Revertive Ringing System; A. E. Lundell, Chicago, Ill. App. filed June 4, 1920. Full mechanical system of large capacity.

1,450,337. Automobile Signal; M. D. Shiverick, Albany, N. Y. App. filed March 14, 1921. Rear direction and stop signal.

1,450,339. Intermittingly Operating Motor System; R. S. Smith and J. L. Adams, Jr., Milwaukee, Wis. App. filed Oct. 20, 1919. Method of driving motor at varying speed in recurrent periods of rising and falling frequency.

1,450,347. Trolley and Feed-Wire Clamp; L. E. Armentrout, Borderland, W. Va. App. filed Jan. 3, 1923. Employed to suspend trolley and feed wires from mine roofs.

1,450,352. Selecting Switch for Use in Telephone Systems; K. Böhme, Berlin-Siemensstadt, Germany. App. filed Nov. 3, 1922. Decreased height of switch.

1,450,362. Electric Coil; P. Gilinson, Lowell, Mass. App. filed Feb. 10, 1919. Means for supporting and insulating various layers of windings of electric coils.

1,450,413. Vacuum Electric Dischagre Device; H. W. Edmundson and W. T. Munro, Rugby, England. App. filed March 10, 1919. Shield mounted in vacuum tube cuts off head radiated from anode.

1,450,415. Protective Device; H. G. French, Schenectady, N. Y. App. filed July 26, 1917. For protecting polyphase motors under unbalanced load conditions.

1,450,420. Sensitized Film Holder for X-Ray Photography; J. A. Heidbrink, Minneapolis, Minn. App. filed April 21, 1921. For dental work.

1,450,425. Protection of Alternating-Current Distributing Circuits; R. V. Bingay, Pittsburgh, Pa. App. filed Oct. 17, 1919. Protection of lines against high voltage of primary side of transformers.

1,450,439. Recording Phonograph; R. Hase, Berlin, Germany. App. filed Feb. 18, 1921. Speech recorded by aid of electromagnetic sound box.

1,450,464. Crystal Formation; E. Thomson, Swampscott, Mass. App. filed July 26, 1920. Alumina, beryllia, etc., made in electric furnace.

1,450,500. Flashlight; C. W. Harvey, New London, Conn. App. filed Jan. 17, 1922. Self-contained generator.

1,450,521. Armature for Dynamo-Electric Machines; A. Steinbach, Chicago, Ill. App. filed Dec. 31, 1921. Sectional armature core with coil on each section.

1,450,533. Storage Battery and Process of Producing the Same; A. H. Williams, Worcester, Mass. App. filed April 16, 1920. Relates to construction of plates.

1,450,543. Method and Device for the Heating of Material in Electric Furnaces; E. A. A. Grönwall, Stockholm, Sweden. App. filed Sept. 28, 1921. For the heattreating of metals.

1,450,563. Trouble-Locating Device; W. T. Powell, Rochester, N. Y. App. filed May 16, 1919. For locating apparatus trouble on telephone systems.

1,450,564. Telephone-Exchange System; F. M. Slough, Rochester, N. Y. App. filed Jan. 24, 1918. Exchange system in which calls are automatically extended by mechanical means to different idle call-receiving apparatus.

1,450,565. Secondary or Storage Battery; E. W. Smith, Philadelphia, Pa. App. filed Jan. 30, 1922. Plate consists of perforated tubes containing active material and metallic cores which act as conductors.

1,450,572. Reversing and Control Switch; O. Bahls, Long Island City, N. Y. App. filed Dec. 15, 1921. For electric vehicles.

1,450,589. Combined Heating and Cooling Device; G. Graff, New York, N. Y. App. filed Jan. 31, 1921. Ventilation system.

1,450,620. System for Regulating Frequency; H. E. Warren, Ashland, Mass. App. filed Dec. 13, 1918. Combined synchronous motor and clock indicates any change in frequency.

1,450,658. Oil-Well Heater; M. Warnick, Los Angeles, Cal. App. filed Dec. 6, 1921. Electric heater placed in bottom of well to facilitate pumping of oil.

1,450,668. Apparatus for Moving Furnace Electrodes; W. Dyrssen, New York, N. Y. App. filed Feb. 25, 1921. Automatically controls raising and lowering of electrodes.

1,450,725. Electrical Resistance Heating Element and Process of Making Same; F. Hodson, Philadelphia, Pa. App. filed May 22, 1922. Resistors of graphitic carbon.

1,450,749. Apparatus for and Method of Controlling Electric Currents; G. W. Pierce, Cambridge, Mass. App. filed March 11, 1914. Control of periodic current by another current or electromotive force the character of which it is desired to alter.

1,450,833. Steam-Heating Appliance; P. Bergeon, Grenoble, France. App. filed Oct. 6, 1921. Water vaporized by electrodes.

1,450,885. Trolley Construction; J. F. Healy, Chicago, Ill. App. filed May 25, 1921. Trolley pole operated by fluid-pressure cylinder.

1,450,898. Motor Controller; H. W. Cheney, Milwaukee, Wis. App. filed Dec. 6, 1919. Compensator for starting motors on low voltage.

1,450,902. Dynamo-Electric Machine; S. H. Mortensen, Milwaukee, Wis. App. filed Dec. 3, 1920. Flywheel for vertical waterwheel generators.

1,451,392. Electrode for Electric Arc Cutting or Reducing; C. J. Holslag, South Orange, N. J. App. filed Nov. 15, 1921. Electrode of rectangular cross-section.

1,451,426. Spark-Gap Apparatus; L. J. Lesh, New York, N. Y. App. filed April 9, 1918. Spark-gap apparatus of the multiple-unit gap type for use in radio transmitting and receiving sets.

1,451,427. Spark-Gap Apparatus; L. J. Lesh, New York, N. Y. App. filed June 5, 1918. Rotary gap for wirelss transmission.

1,451,465. Power-Transmission Apparatus; A. H. Neuland, San Francisco, Cal. App. filed May 13, 1916. Engine-generator-motor set for vehicles.

1,451,495. Audible Signal Device; J. L. Dinsmoor, Philadelphia, Pa. App. filed Aug. 7, 1917. Vibrating electric horns for automobiles.

1,451,500. Process and Means for Removing Corroded Terminals for Storage Batteries; G. E. Frohbeiter, Princeton, Ind. App. filed Sept. 11, 1922. By heating corrosion.

1,451,501. Speed-Regulating Apparatus; V. A. Fynn, St. Louis, Mo. App. filed July 5, 1919. Electromagnetic means for controlling supply of fuel to internal-combustion engines.

1,451,502. Speed-Regulating Apparatus; V. A. Fynn, St. Louis, Mo. App. filed July 5, 1919. Electromagnetic control for internal-combustion engines.

1,451,529. Resistor Element; Q. A. Brackett, Pittsburgh, Pa. App. filed Aug. 5, 1919. Grid leaks for vacuum-tube radio sets.

1,451,537. Electric Heater; M. D. Dominguez, New Orleans, La. App. filed May 1, 1922. Automatic water heater.

1,451,539. Electric Heating System for Ironing Machines; F. F. Forshee, Flint, Mich. App. filed Feb. 14, 1921. Method of maintaining constant temperature on heating surfaces.

1,451,543. Electroplating with Zinc; J. Haas, Jr., Muncie, Ind. App. filed Sept. 16, 1922. Electroplating of zinc or its alloys upon iron or steel in cyanide baths.

1,451,548. Contact Terminal; H. Kreisheld, Mansfield, Ohio. App. filed Nov. 20, 1919. Plug-and-socket contact for electrically heated apparatus.

1,451,550. Starting System for Automobiles; W. P. Loudon, Edgewood Park, Pa. App. filed April 14, 1920. Starting motor.

1,451,555. Arc-Welded Truss; W. Schenstrom, Brooklyn, N. Y. App. filed Oct. 11, 1920. Relates to framed-beam building construction.

1,451,556. Electric Percolator; F. Thornton, Jr., Wilkinsburg, Pa. App. filed June 29, 1922. Simple construction of vaporizing chamber.

1,451,558. Electropercussive Welding System; C. F. Wagner, Pittsburgh, Pa. App. filed May 14, 1921. Automatic control.

1,451,559. Section Insulator; N. A. Wahlberg, Wilkinsburg, Pa. App. filed June 3, 1921. For trolley wires.

1,451,577. Dynamo-Electric Machine; P. H. H. Jantzen, London, England. App. filed April 10, 1920. Means for cooling stator and rotor of dynamo-electric machines.

1,451,618. Flashlight; H. M. Koretzky, New York, N. Y. App. filed June 27, 1921. Accidental lighting prevented.

1,451,623. Soldering Iron; E. Millner, St. Louis, Mo. App. filed May 3, 1920. Electric heating element.

1,451,636. Electric Heater; R. Ullrich, Wels, Austria. App. filed Sept. 12, 1922. Cooking apparatus heated by electric energy, with automatic device for making and breaking circuit.

1,451,671. Electric Water Heater; W. G. Carter, Monrovia, and F. W. Thompson, Arcadia, Cal. App. filed Feb. 28, 1922. Tank heating system for hot-water-pipe lines.